AIRIE

APPLIED ISOTOPE RESEARCH

August 2018

The AIRIE Program pioneered Re-Os (rhenium-osmium) technology in crustal environments, and is the global leader in developing sampling protocols to work with geologic media. Since 1995, AIRIE has produced state-of-the-art Re-Os geochronology and Os isotopic tracer studies, framed by geologic observation at all scales. Two multi-collector Triton mass spectrometers built for Re-Os analytical work and two wet-chemistry labs belong to the Program. Collaborating partners span 85 countries and discoveries benefit a large cross-section of the geosciences, from atmosphere to deep earth. We address fundamental scientific questions and use the results to advance science and enhance discovery in the petroleum and mineral industries. The AIRIE analytical facility is a designated research unit benefitting Colorado State University, reporting to the Vice President of Research. All salaries and the Program's operation rely on external grants and contracts; that is, Colorado State University provides no financial support. The AIRIE Program has forged a long-term partnership with research entities in Norway, making Norwegian economic interests the geologic base for our fundamental scientific discoveries, for example, Re-Os dating of molybdenite and other sulfides, dating of oils and bitumens, and most recently, reconstruction of whole petroleum systems in absolute time. Our scientific publications and contributions are tallied under the Department of Geosciences' website, and constitute 35-40% of the Department's yearly research output.

Re-Os isotope geochemistry enlightens our understanding of how metal and hydrocarbon resources are created, interrelated, and where they are located.

Metals **– Our work has led directly to discovery of ore and sometimes challenges long-standing models for ore formation. AIRIE established the protocols for successful Re-Os ID-TIMS dating of molybdenite. We discovered the unique phenomenon of parent-daughter (^{187}Re-^{187}Os) decoupling in molybdenite prompting new approaches for acquiring mineral separates. We developed a double Os spike to address young (or low Re) molybdenites, sharing this approach with the geochemistry community. We acquired and characterized a molybdenite reference material (NIST, RM #8599) from the Henderson molybdenum mine (mill) in Colorado. We work with other sulfide and oxide minerals such as pyrite, marcasite, arsenopyrite, chalcopyrite, pyrrhotite and magnetite to provide age(s) and fluid source information.**

Hydrocarbons **– Our work with hydrocarbons includes direct dating of organic material in source rocks, and dating *in situ* and migrated bitumen and oil. In 2016, we published the first Re-Os isochron for a single crude oil. We work with the hydrogenous component in black shales, and asphaltene and maltene components in oils. Re-Os analyses of hydrocarbons are used to model maturation-migration in both conventional and unconventional systems. Our work on sulfides and organic material in shales calibrates Earth's timescale, and determines rates for sedimentologic, bio-evolutionary, and tectonic processes, giving perspective on ancient climates, oceans, global correlation of fauna, and atmospheric evolution. We provided the first date for the rise of atmospheric oxygen (*Nature* 2004, 1002 citations).**

For more information, please contact:

Dr. Holly J. Stein

Director, AIRIE Program, Senior Research Scientist and Professor

Colorado State University, Fort Collins, CO 80523-1482 USA

CEED Centre of Excellence, University of Oslo, 0371 Oslo, Norway

holly.stein@colostate.edu www.airieprogram.org

AIRIE PROGRAM, COLORADO STATE UNIVERSITY: RE-OS PUBLICATIONS

Holly Stein (Founding Director, Senior Research Scientist and Professor)
Judith Hannah (Professor)
Aaron Zimmerman (Lab Manager and Research Associate)
Svetoslav Georgiev, Gang Yang, Rich Markey (Research Associates)
Vineet Goswami and Nicole Hurtig (Post-Docs)
Jenna DiMarzio and Marisa Boraas-Connor (Recent Graduate Students)

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Refereed Journal Papers:

Scarlett, A.G., Holman, A.I., Summons, R.G., Georgiev, S.V., Stein, H.J., and Grice, K. (in co-author review) Multi spectroscopic, elemental and Re-Os characterization of southern Australian asphaltites: *Geochimica et Cosmochimica Acta*.

Hurtig, N.C., Georgiev, S.V., Zimmerman, A., Yang, G., Goswami, V., Hannah, J.L., and Stein, H.J. (in co-author review) Re-Os geochronology in petroleum: NIST RM8505, asphaltene precipitations and uncertainty: for *Journal of Geostandards and Geoanalytical Research*.

Georgiev, S.V., Stein, H.J., Hannah, J.L., Yang, G., Markey, R.J., Dons, C.E., Petersen, J-H., Di Primio, R. (in co-author review) Temporal evolution of the Brynhild petroleum system, Norwegian North Sea: for *Geochimica et Cosmochimica Acta*.

Hall, W.S., Stein, H.J., Kylander-Clark, A.R.C., Knight, C., Enders, M.S., and Hitzman, M.W. (in co-author review) Re-Os sulfide and U-Th-Pb xenotime geochronology of sedimentary rock-hosted Cu-Ag deposits, Kalahari Copperbelt, Botswana: *Economic Geology*.

Goswami, V., Stein, H.J., and Hannah, J.L. (in co-author review) Re-Os geochemistry of Fish Clay, black nodular cherts, and chalks across the Cretaceous-Paleogene (K-Pg) boundary at Stevns Klint, Denmark, for *Palaeogeography, Palaeoclimatology, Palaeoecology.*

Stewart, P.W., Stein, H.J., and Roa, K. (in co-author review) U-Pb, $^{40}Ar/^{39}Ar$, and Re-Os geochronology of the Fruita del Norte epithermal gold-silver deposit, southeast Ecuador: for *Economic Geology*.

Bussey, S.D., Kakarieka, A., Friedman, R.M., Stein, H.J., Gabites, J.E. (in co-author review) Timing of magmatism and skarn mineralization at the Limon, Guajes and Media Luna Au-Ag-(Cu) skarn deposits at Morelos, Guerrero State, Mexico: for *Economic Geology*.

Febbo, G.E, Kennedy, L.A., Nelson, J., Savell, M., Campbell, M.E., Creaser, R.A., Friedman, R.M., van Straaten, B.I., and Stein, H.J. (submitted) The supergiant Mitchell Au-Cu giant porphyry, northwest BC: effect of syn-mineral structures and alteration on deformation and strain localization: *Economic Geology*.

Kouhestani, H., Mokhtari, M.A.A., Chang, Z., Stein H., and Johnson, C. (in review) Timing and genesis of ore formation in the Qarachilar Cu-Mo-Au deposit, Tethyan metallogenic belt, NW

Iran: Evidence from geology, fluid inclusions, O-S isotopes and Re-Os geochronology: *Ore Geology Reviews*.

Boomeri, M., Moradi, R., Stein, H.J., and Bagheri, S. (in review) Geology, Re-Os age, ^{34}S and ^{18}O isotopic composition of the Lar Cu-Mo deposit, southeast Iran: *Ore Geology Reviews*.

Hurtig, N.C., Georgiev, S.V., Stein, H.J., and Hannah, J.L. (in revision) Controlling factors on Re-Os systematics in petroleum during water-oil interaction: the effects of oil chemistry, water-oil ratio and interaction time: *Geochimica et Cosmochimica Acta*.

Molnár, F., Middleton, A., Stein, H., O'Brien, H., Lahaye, Y., Huhma, H., Pakkanen, L., Johansen, B. (in press) Repeated syn- and post-orogenic gold mineralization events between 1.92 and 1.76 Ga along the Kiistala shear zone in the Central Lapland Greenstone Belt: *Mineralium Deposita*.

Tripathy, G.R., Hannah, J.L., Stein, H.J. (2018) Refining the Jurassic-Cretaceous boundary: Re-Os geochronology and depositional environment of Upper Jurassic shales from the Norwegian Sea: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 503, p. 13-25. (https://doi.org/10.1016/j.palaeo.2018.05.005)

Georgiev, S.V., Zimmerman, A., Yang, G., Goswami, V., Hurtig, N., Stein, H.J., and Hannah, J.L. (2018) Comparison of chemical procedures for Re-isotopic measurements by N-TIMS: *Chemical Geology*, v. 483, p. 151-161. (https://doi.org/10.1016/j.chemgeo.2018.03.006)

Goswami, V., Hannah, J.L., Stein, H.J. (2018) Why terrestrial coals cannot be dated using the Re-Os geochronometer: Evidence from the Finnmark platform, southern Barents Sea and the Fire Clay coal horizon, central Appalachian basin: *International Journal of Coal Geology*, v. 188, p. 121-135. (https://doi.org/10.1016/j.coal.2018.02.005)

DiMarzio, J., Georgiev, S.V., Stein, H.J., and Hannah, J.L. (2018) Residency of rhenium and osmium in a heavy crude oil: Geochimica et Cosmochimica Acta, v. 220, p. 180-200. (https://doi.org/10.1016/j.gca.2017.09.038)

Molnár, F., O'Brien, H., Stein, H., and Cook, N. (2017) Geochronology of hydrothermal processes leading to the formation of the Rompas Au-U prospect, Peräpohja belt, northern Finland: application of paired U-Pb dating of uraninite and Re-Os dating of molybdenite to the identification of multiple hydrothermal events in a metamorphic terrane: *Minerals*, v. 7, no. 9, paper 171, 23 pgs. (https://doi.org/10.3390/min7090171)

Hora, Z.D., Stein, H., Zak, K., and Dobes, P. (2017) Eaglet property, southeastern British Columbia: Re-Os geochronology, sulphur isotopes, and thermobarometry: *British Columbia Geological Survey Paper* 2018-1, p. 157-166. (PDF Link)

Larsen, A.O., Stein, H.J., Hannah, J.L., and Zimmerman, A. (2017) Re-Os ages for molybdenites from the Saga I and Sagåsen larvikite quarries, Oslo Rift, south Norway: *Norsk Mineralsymposium*, p. 77-84. [ISBN 978-82-690027-2-0]

Lu, X. Kendall, B., Stein, H.J., and Hannah, J.L. (2017) Temporal record of osmium concentrations and isotopic compositions in organic-rich mudrocks: Implications for evolution of the

seawater Os reservoir: *Geochimica et Cosmochimica Acta*, v. 216, p. 221-241. (https://doi.org/10.1016/j.gca.2017.06.046)

Hollanda, M.H., Souza Neto, J.A., Archanio, C., Stein, H., and Sartorato, A. (2017) Age of granitic magmatism and W-Mo mineralization in skarns of the Seridó Belt (NE Brazil) based on zircon U-Pb (SHRIMP) and molybdenite Re-Os ages: *Journal of South American Earth Sciences*, v. 79, p. 1-11. (https://doi.org/10.1016/j.jsames.2017.07.011)

Lu, X. Kendall, B., Stein, H.J. Li, C., Hannah, J.L., Gordon, G.W., and Ebbestad, J.O. (2017) Marine redox conditions during deposition of Late Ordovician and Early Silurian organic-rich mudrocks in the Siljan ring district, central Sweden: *Chemical Geology*, v. 457, p. 75-94. (https://doi.org/10.1016/j.chemgeo.2017.03.015)

Mohammaddoost, H., Ghaderi, M., Kumar, T.V., Hassanzadeh, J., Alirezaei, S., Stein, H.J., Babu, E.V. (2017) Zircon U-Pb and molybdenite Re-Os geochronology, with S isotopic composition of sulfides from the Chah-Firouzeh porphyry Cu deposit, Kerman Cenozoic arc, SE Iran: *Ore Geology Reviews*, v. 88, p. 384-399. (https://doi.org/10.1016/j.oregeorev.2017.05.023)

Torró, L., Camprubí, A., Proenza, J.A., León, P., Stein, H.J., Lewis, J.F., Nelson, C.E., Chavez, C., Melgarejo, J.C. (2017) Re-Os and U-Pb geochronology of the Doña Amanda and Cerro Kiosko deposits, Bayaguana district, Dominican Republic: looking down for the porphyry Cu-Mo roots of Pueblo Viejo-type mineralization in the island arc tholeiitic series of the Caribbean: *Economic Geology,* v. 112, p. 829-853. (https://doi.org/10.2113/econgeo.112.4.829)

Georgiev, S.V., Stein, H.J., Hannah, J.L., Xu, G., Bingen, B., and Weiss, H.M. (2017) Timing, duration, and causes for Late Jurassic-Early Cretaceous anoxia in the Barents Sea: *Earth and Planetary Science Letters*, v. 461, p. 151-162. (https://doi.org/10.1016/j.epsl.2016.12.035)

Li, J., Zhang, Z., Stern R.A., Hannah, J.L., Stein, H.J., Yang, G., and Li, L. (2017) Primary multiple sulfur isotopic compositions of pyrite in 2.7 Ga shales from the Joy Lake sequence (Superior Province) show felsic volcanic array-like signature: *Geochimica et Cosmochimica Acta*, v. 202, p. 310-340. (https://doi.org/10.1016/j.gca.2016.12.037)

Markey, R.J., Stein, H.J., Hannah, J.L., Georgiev, S.V., Pedersen, J.H., and Dons, C.E. (2017) Re-Os identification of glide faulting and precise ages for correlation from the Upper Jurassic Hekkingen Formation, southwestern Barents Sea: *Palaeogeography, Palaeoclimatology, Palaeoecology,* v. 466, p. 209-220. (https://doi.org/10.1016/j.palaeo.2016.11.032)

Georgiev, S.V., Stein, H.J., Hannah, J.L., Galimberti, R., Nali, M., Yang, G., and Zimmerman, A. (2016) Re-Os dating of maltenes and asphaltenes within single samples of crude oil: *Geochimica et Cosmochimica Acta*, v. 179, p. 53-75. (https://doi.org/10.1016/j.gca.2016.01.016)

Yang, G., Zimmerman, A., Stein, H. and Hannah, J. (2015) Pretreatment of nitric acid with hydrogen peroxide reduces total procedural Os blank to femtogram levels: *Analytical Chemistry*, v. 87, p. 7017-7021. (https://doi.org/10.1021/acs.analchem.5b01751)

Tripathy, G.R., Hannah, J.L., Stein, H.J., Geboy, N.J., Ruppert, L.F. (2015) Radiometric dating of marine-influenced coal using Re-Os geochronology: *Earth and Planetary Science Letters*, v, 432, p. 13-23. (https://doi.org/10.1016/j.epsl.2015.09.030)

Torgersen, E., Viola, G., Sandstad, J.S., Stein, H., Zwingmann, H., and Hannah, J. (2015) Effects of frictional-viscous oscillations and fluid flow events on the structural evolution and Re-Os pyrite-chalcopyrite systematics of Cu-rich carbonate veins in northern Norway: *Tectonophysics*, v. 659, p. 70-90. (https://doi.org/10.1016/j.tecto.2015.07.029)

Hawke, M., Meffre, S., Stein, H., Hillard, P., Large, R., Gemmell, B. (2015) Geochronology of the DeGrussa volcanic-hosted massive sulfide deposit and associated mineralisation of the Yerrida, Bryah and Padbury Basins, Western Australia: *Precambrian Research*, v. 267, p. 250-284. (https://doi.org/10.1016/j.precamres.2015.06.011)

Drábek, M. and Stein, H. (2015) Molybdenite Re-Os dating of Mo-Th-Nb-REE-rich marbles: pre-Variscan history in the Moldanubian Variegated Group, Czech Republic: *Geologica Carpathica*, v. 66, no. 3, p. 173-179. (https://doi.org/10.1515/geoca-2015-0018)

Catchpole, H., Kouzmanov, K., Bendezú, A., Ovtcharova, M., Spikings, R., and Stein, H., and Fontboté L. (2015) Timing of porphyry (Cu-Mo) and base metal mineralisation (Zn-Pb-Ag-Cu) in a magmatic-hydrothermal system – Morococha district, Peru: *Mineralium Deposita*, v. 50, p. 895-922. (https://doi.org/10.1007/s00126-014-0564-x)

Nelson, C.E., Stein, H.J., Dominguez, H., Carrasco, C., Barrie, T., Torró, L., and Proenza, J. (2015) Re-Os dating of molybdenite from the Pueblo Viejo Au-Ag-Cu and Douvray Cu-Au districts, Hispaniola: *Economic Geology*, v. 110, p. 1101-1110. (https://doi.org/10.2113/econgeo.110.4.1101)

Bingen, B., Corfu, F., Stein, H.J., Whitehouse, M.J. (2015) U-Pb geochronology of the syn-orogenic Knaben molybdenum deposits, Sveconorwegian orogeny, Norway: *Geological Magazine*, v. 152, no. 3 p. 537-556. (https://doi.org/ 10.1017/S001675681400048X)

Geboy, N.J., Tripathy, G.R., Ruppert, L.F., Eble, C.F., Blake, B.M., Hannah, J.L., and Stein, H.J. (2015) Re-Os age for the Lower-Middle Pennsylvanian boundary and comparison with associated palynoflora: *International Journal of Coal Geology*, v. 140, p. 23-30. (https://doi.org/10.1016/j.coal.2015.01.002)

Georgiev, S.V., Stein, H.J., Hannah, J.L., Henderson, C.M., and Algeo, T. (2015) Enhanced recycling of organic matter and Os-isotopic evidence for multiple magmatic or meteoritic inputs to the Late Permian Panthalassic Ocean, Opal Creek, Canada: *Geochimica et Cosmochimica Acta*, v. 150, p. 192-210. (https://doi.org/10.1016/j.gca.2014.11.019)

Georgiev, S.V., Horner, T.J., Stein, H.J., Hannah, J.L., Bingen, B., and Rehkämper, M. (2015) Cadmium-isotopic evidence for increasing primary productivity during the Late Permain anoxic event: *Earth and Planetary Science Letters*, v. 410, p. 84-96. (https://doi.org/10.1016/j.epsl.2014.11.010)

Capistrant, P.L., Hitzman, M.W., Wood, D., Kelly, N., Williams, G., Zimba, M., Kuiper, Y., Jack, D., Stein, H. (2015) Geology of the Enterprise hydrothermal nickel deposit, North-western Province, Zambia: *Economic Geology*, v. 38, p. 9-38. (https://doi.org/10.2113/econgeo.110.1.9)

Stein, H. and Hannah, J. (2015) Rhenium-Osmium geochronology – sulfides, shales, oils, and mantle, *in* Rink, J. and Thompson, J. (eds), Earth Sciences Series, Encyclopedia of Scientific Dating Methods, Springer. http://link.springer.com/referencework/10.1007/978-94-007-6326-5. (https://doi.org/10.1007/978-94-007-6326-5_36-1)

Zimmerman, A., Stein, H., Morgan, J.W., Markey, R.J., and Watanabe, Y. (2014) Re-Os geochronology of the El Salvador porphyry Cu-Mo deposit, Chile: tracking analytical improvements in accuracy and precision over the past decade: *Geochimica et Cosmochimica Acta*, v. 131, p. 13-32. (https://doi.org/10.1016/j.gca.2014.01.016)

Tripathy, G.R., Hannah, J.L., Stein, H.J., and Yang, G. (2014) Re-Os age and depositional environment for black shales from the Cambrian-Ordovician boundary, Green Point, western Newfoundland: *Geochemistry, Geophysics, Geosystems*, v. 15, p. 1021-1037. (https://doi.org/10.1002/2013GC005217)

Yakubchuk, A., Stein, H., and Wilde, A. (2014) Results of pilot Re-Os dating of sulfides from the Sukhoi Log and Olympiada orogenic gold deposits, Russia: *Ore Geology Reviews*, v. 59, p. 21-28. (https://doi.org/10.1016/j.oregeorev.2013.12.003)

Xu, G., Hannah, J.L., Stein, H.J., Mørk, A., Vigran, J.O., Bingen, B., Schutt, D., and Lundschien, B.A. (2014) Cause of Upper Triassic climate crisis revealed by Re-Os geochemistry of Boreal black shales: *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 395, p. 222-232. (https://doi.org/10.1016/j.palaeo.2013.12.027)

Kamvong, T., Zaw, K., Meffre, S., Maas, R., Stein, H., and Lai, C.-K. (2014) Adakites in the Truong Son and Loei fold belts, Thailand and Laos: genesis and implications for geodynamics and metallogeny: *Gondwana Research*, v. 26, p. 165-184. (https://doi.org/10.1016/j.gr.2013.06.011)

Stein, H.J. (2014) Dating and Tracing the History of Ore Formation, *in* Holland, H.D. and Turekian, K.K. (editors) Treatise on Geochemistry, Second Edition, v. 13, p. 87-118. Oxford: Elsevier. (https://doi.org/10.1016/B978-0-08-095975-7.01104-9)

Rapprecht, R., Stewart, K.G., LaPoint, D., and Stein, H. (2013) The Deep River gold-copper-molybdenum prospect: potential subvolcanic porphyry mineralization, Moore and Randolph counties, central North Carolina, *in* Hibbard, J. and Pollock, J. (eds) *One arc, two arcs, old arc, new arc; the Carolina terrane in central North Carolina*. Carolina Geological Society Field Guidebook, p. 193-211.

Gawęda, A., Müller, A., Stein, H., Kadziołko-Gaweł, M., Mikulski, S. (2013) Age and origin of tourmaline-rich hydraulic breccias in the Tatra granite, Western Carpathians: *Journal of Geosciences*, v. 58, p. 133-148. (https://doi.org/10.3190/jgeosci.140)

Golden, J., McMillan, M., Downs, R.T., Hystad, G., Goldstein, I., Stein, H.J., Zimmerman, A., Sverjensky, D.A., Armstrong, J.T., and Hazen, R.M. (2013) Rhenium variations in molybdenite (MoS_2): Evidence for progressive subsurface oxidation: *Earth and Planetary Science Letters*, v. 366, p. 1-5. (https://doi.org/10.1016/j.epsl.2013.01.034)

Kohút, M., Stein, H., Uher, P., Zimmerman, A., and Hraško, L. (2013) Re-Os and U-Th-Pb dating of the Rochovce granite and its mineralization (Western Carpathians, Slovakia): *Geologica Carpathica*, v. 64, p. 71-79. (https://doi.org/10.2478/geoca-2013-0005)

Demaiffe, D., Wiszniewska, J., Krzemińska, E., Williams, I.S., Stein, H., Brassinnes, S., Ohnenstetter, D., and Deloule, E. (2013) A hidden alkaline and carbonatite province of Early Carboniferous age in NE Poland: zircon U-Pb and pyrrhotite Re-Os geochronology: *Journal of Geology*, v. 121, p. 91-104. (https://doi.org/10.1086/668674)

Rosera, J.M., Coleman, D.S., and Stein, H.J. (2013) Re-evaluating genetic models for porphyry Mo mineralization at Questa, New Mexico: Implications for ore deposition following silicic ignimbrite eruption: *Geochemistry, Geophysics, Geosystems* v. 14, no. 4, p. 787-805. (https://doi.org/10.1002/ggge.20048)

Drobe, J., Lindsay, D., Stein, H. and Gabites, J. (2013) Geology, mineralization, and geochronological constraints of the Mirador Cu-Au porphyry district, southeast Ecuador: *Economic Geology*, v. 108, p. 11-35. (https://doi.org/10.2113/econgeo.108.1.11)

Hehnke, C., Ballantyne, G., Martin, H., Hart, W., Schwarz, A., and Stein, H. (2012) Geology and exploration progress at the Resolution porphyry Cu-Mo deposit, Arizona: *Society of Economic Geologists Special Publication* 16, p. 147-166.

Hannah, J.L. and Stein, H.J. (2012) Re-Os Geochemistry, *in* Melezhik, V.A., Kump, L.R., Fallick, A.E., Strauss, H., Hanski, E.J., Prave, A.R., and Lepland, A., (editors), Reading the Archive of Earth's Oxygenation, Volume 3: Global Events and the Fennoscandian Arctic Russia – Drilling Early Earth Project: Springer-Verlag, Berlin, Heidelberg, p. 1506-1514. (https://doi.org/10.1007/978-3-642-29670-3)

Mikulski, S.Z. and Stein, H.J. (2012) Wiek molibdenitów w Polsce w świetle badań izotopowych Re-Os. Biuletyn Państwowego Instytutu Geologicznego: 452: 199-216.

Lehnert, O., Meinhold, G., Bergström, S.M., Calner, M., Ebbestad, J.O.R., Egenhoff, S., Frisk, Å.M., Hannah, J.L., Högström, A.E.S., Huff, W.D., Julin, C., Maletz, J., Stein, H.J., Sturkell, E., Vandenbroucke, T.R.A. (2012) New Ordovician-Silurian drill cores from the Siljan impact structure in central Sweden: an integral part of the Swedish Deep Drilling Program: *GFF (A Scandinavian Journal of Earth Sciences)*, v. 134, p. 87-98. (https://dx.doi.org/10.1080/11035897.2012.692707)

Sardi, F.G. and Stein, H. (2012) Age of the Angulos W-Mo mineralization from the Paimán Range (NW Argentina) and its geological significance: *Neues Jahrbuch für Geologie und Paläontologie-Abhandlungen*, v. 266, p. 149-157. (https://doi.org/10.1127/0077-7749/2012/0289)

Georgiev, S., Stein, H.J., Hannah, J.L., Weiss, H.M., Bingen, B., Xu, G., Rein, E., Hatlø, V., Løseth, H., Nali, M., Piasecki, S. (2012) Chemical signals for oxidative weathering predict Re-Os isochroneity in black shales, East Greenland: *Chemical Geology*, v. 324-325, p. 108-121. (https://doi.org/10.1016/j.chemgeo.2012.01.003)

Xu, G., Hannah, J.L., Bingen, B., Georgiev, S., and Stein, H.J. (2012) Digestion methods for trace element measurements in shales: paleoredox proxies examined: *Chemical Geology*, v. 324-325, p. 132-147. (https://doi.org/10.1016/j.chemgeo.2012.01.029)

Braxton, D.P., Cooke, D.R., Dunlap, J., Norman, M., Reiners, P., Stein, H., Waters, P. (2012) From crucible to graben in 2.3 Ma: A high-resolution geochronological study of porphyry life cycles, Boyongan-Bayugo copper-gold deposits, Phillippines: *Geology*, v. 40, no. 5, p. 471-474. (https://doi.org/10.1130/G33125.1)

Förster, H.-J., Rhede, D., Stein, H.J., Romer, R.L., and Tischendorf, G. (2012) Paired uraninite and molybdenite dating of the Königshain granite; implications for the onset of late-Variscan magmatism in the Lausitz Block: *International Journal of Earth Sciences*, v. 101, p. 57-67. (https://doi.org/10.1007/s00531-010-0631-1)

Georgiev, S., Stein, H.J., Hannah, J.L., Bingen, B., Weiss, H.M., and Piasecki, S. (2011) Hot acidic Late Permian seas stifle life in record time: *Earth and Planetary Science Letters*, v. 310, p. 389-400. (https://doi.org/10.1016/j.epsl.2011.08.010)

Duncan, R., Stein, H., Evans, K., Hitzman, M., Nelson, E., and Kirwin, D. (2011) A new geochronological framework for mineralization and alteration in the Selwyn-Mount Dore Corridor, Eastern Fold Belt, Mount Isa Inlier, Australia: genetic implications for iron oxide-copper-gold deposits: *Economic Geology*, v. 106, no. 2, p. 169-192. (https://doi.org/10.2113/econgeo.106.2.169)

Xu, G., Hannah, J.L., Stein, H.J., Bingen, B., Yang, G., Zimmerman, A., Weitschat, W., Mørk, A., Weiss, H.M. (2009) Re–Os geochronology of Arctic black shales to evaluate the Anisian–Ladinian boundary and global faunal correlations: *Earth and Planetary Science Letters*, v. 288, p. 581-587. (https://doi.org/10.1016/j.epsl.2009.10.022)

Oberthür, T., Melcher, F., Henjes-Kunst, F., Gerdes, A., Stein, H., Zimmerman, A., and El Ghorfi, M. (2009) Hercynian age of the cobalt-nickel-arsenide-(gold) ores, Bou Azzer, Anti-Atlas, Morocco: Re-Os, Sm-Nd, and U-Pb age determinations: *Economic Geology*, v. 104, p. 1065-1079. (https://doi.org/10.2113/econgeo.104.7.1065)

Yang, G., Hannah, J.L., Zimmerman, A., Stein, H.J., and Bekker, A. (2009) Re-Os depositional age for Archean carbonaceous slates from the southwestern Superior Province: challenges and insights: *Earth and Planetary Science Letters*, v. 280, p. 83-92. (https://doi.org/10.1016/j.epsl.2009.01.019)

Chiaradia, M., Vallance, J., Fontboté, L., Stein, H., Schaltegger, U., Coder, J., Richards, J., Villeneuve, M., and Gendall, I. (2009) U-Pb, Re-Os, and $^{40}Ar/^{39}Ar$ geochronology of the Nambija Au-skarn and Pangui porphyry Cu deposits, Ecuador: implications for the Jurassic metallogenic belt of the northern Andes: *Mineralium Deposita*, v. 44, no. 4, p. 371-387. (https://doi.org/10.1007/s00126-008-0210-6)

Bjerkgård, T., Stein, H.J., Bingen, B., Sandstad, J.S., Henderson, I.C., and Moniz, A. (2009) The Niassa gold belt, northern Mozambique – a segment of a continent-scale Pan-African gold-bearing structure?: *Journal of African Earth Sciences*, v. 53, no. 1-2, p. 45-58. (https://doi.org/10.1016/j.jafrearsci.2008.09.003)

Kelson C.R., Crowe, D.E., and Stein, H.J. (2008) Geochemical and geochronological constraints on mineralization within the Hilltop, Lewis, and Bullion mining districts, Battle Mountain-Eureka trend, Nevada: *Economic Geology*, v. 103, no. 7, p. 1483-1506. (https://doi.org/10.2113/gsecongeo.103.7.1483)

Bingen, B., Davis, W.J., Hamilton, M.A., Stein, H.J., Engvik, A., Skår, Ø., and Nordgulen, Ø. (2008) Geochronology of high-grade metamorphism in the Sveconorwegian belt, S Norway: U-Pb, Th-Pb, and Re-Os data: *Norwegian Journal of Geology*, v. 88, p. 13-42.

Mueller, A.G., Hall, G.C., Nemchin, A.A., Stein, H.J., Creaser, R.A., and Mason, D.R. (2008) Archean high-Mg monzodiorite-syenite, epidote skarn, and biotite-sericite gold lodes in the Granny Smith-Wallaby district, Australia: U-Pb and Re-Os chronometry of two intrusion-related hydrothermal systems: *Mineralium Deposita*, v. 43, p. 337-362. (https://doi.org/10.1007/s00126-007-0164-0)

Zimmerman, A., Stein, H.J., Hannah, J.L., Kozelj, D., Bogdanov, K., and Berza, T. (2008) Tectonic configuration of the Apusini-Banat-Timok-Srednogorie belt, Balkans-South Carpathians,

constrained by high precision Re-Os molybdenite ages: *Mineralium Deposita*, v. 43, p. 1-21. (https://doi.org/10.1007/s00126-007-0149-z)

Cannell, J., Cooke, D.R., Walshe, J.L., and Stein, H. (2007) Geology, mineralization, alteration and structural evolution of El Teniente porphyry Cu-Mo deposit – a reply: *Economic Geology*, v. 102, no. 6, p. 1171-1180. (https://doi.org/10.2113/gsecongeo.102.6.1171)

Mikulski, S.Z. and Stein, H.J. (2007) Re-Os ages for molybdenites from the western Sudetes, SW Poland: Granites in Poland (Eurogranites Conference), *Archiwum Mineralogiczne Monograph* No. 1, p. 203-216.

Markey, R., Stein, H.J., Hannah, J.L., Zimmerman, A., Selby, D., and Creaser, R.A. (2007) Standardizing Re-Os geochronology: a new molybdenite Reference Material (Henderson, USA) and the stoichiometry of Os salts: *Chemical Geology*, v. 244, p. 74-87. (https://doi.org/10.1016/j.chemgeo.2007.06.002)

Smith M., Coppard, J., Herrington, R., and Stein, H. (2007) The geology of the Rakkurijärvi Cu-(Au) prospect, Norrbotten: a new IOCG deposit in northern Sweden: *Economic Geology*, v. 102, no. 3, p. 393-414. (https://doi.org/10.2113/gsecongeo.102.3.393)

Hannah, J.L., Stein, H.J., Wieser, M.E., de Laeter, J.R., and Varner, M. (2007) Mo isotope variations in molybdenite: Vapor transport and Rayleigh fractionation of Mo: *Geology*, v. 35, no. 8, p. 703-706. (https://doi.org/10.1130/G23538A.1)

Wilson, A.J., Cooke, D.R., Stein, H.J., Fanning, C.M., Holliday, J.R., and Tedder, I.J. (2007) U-Pb and Re-Os geochronologic evidence for two alkalic porphyry ore-forming events in the Cadia district, New South Wales, Australia: *Economic Geology*, v. 102, no. 2, p. 3-26. (https://doi.org/10.2113/gsecongeo.102.1.3)

Selby, D., Creaser, R.A., Stein, H.J., Markey, R.J., and Hannah, J.L. (2007) Assessment of the ^{187}Re decay constant by cross calibration of Re-Os molybdenite and U-Pb zircon chronometers in magmatic ore systems: *Geochimica et Cosmochimica Acta*, v. 71, no. 8, p. 1999-2013. (https://doi.org/10.1016/j.gca.2007.01.008)

Romer, R.L., Thomas, R., Stein, H.J., and Rhede, D. (2007) Dating multiply overprinted Sn-mineralized granites – examples from the Erzgebirge, Germany: *Mineralium Deposita*, v. 42, p. 337-359. (https://doi.org/10.1007/s00126-006-0114-2)

Mao, J., Wang, Y., Lehmann, B., Yu, J., Du, A., Mei, Y., Li, Y., Zang, W., Stein, H.J., and Zhou, T. (2006) Molybdenite Re-Os and albite ^{40}Ar/^{39}Ar dating of Cu-Au-Mo and magnetite porphyry systems in the Yangtze River valley and metallogenic implications: *Ore Geology Reviews*, v. 29, p. 307-324. (https://doi.org/10.1016/j.oregeorev.2005.11.001)

Raith, J.G. and Stein, H.J. (2006) Variscan ore formation and metamorphism at the Felbertal scheelite deposit (Austria): constraining tungsten mineralisation from Re-Os dating of molybdenite: *Contributions to Mineralogy and Petrology*, v. 152, p. 505-521. (https://doi.org/10.1007/s00410-006-0118-z)

Bierlein, F.P., Stein, H.J., Coira, B., and Reynolds, P. (2006) Timing of gold and crustal evolution of the Paleozoic south central Andes, NW Argentina – implications for the endowment of orogenic belts:

Earth and Planetary Science Letters, v. 245, p. 702-721. (https://doi.org/10.1016/j.epsl.2006.03.019)

Stein, H.J. (2006) Low-rhenium molybdenite by metamorphism in northern Sweden: recognition, genesis, and global implications: *Lithos*, v. 87, p. 300-327. (https://doi.org/10.1016/j.lithos.2005.06.014)

Bingen, B., Stein, H.J., Bogaerts, M., Bolle, O., and Mansfeld, J. (2006) Molybdenite Re-Os dating constrains gravitational collapse of the Sveconorwegian orogen, SW Scandinavia: *Lithos*, v. 87, p. 328-346. (https://doi.org/10.1016/j.lithos.2005.06.017)

Stein, H., Hannah, J., Zimmerman, A., and Markey, R. (2006) Mineralization and deformation of the Malanjkhand terrane (2490-2440 Ma) along the southern margin of the Central Indian Tectonic Zone: *Mineralium Deposita*, v. 40, p. 755-765. (https://doi.org/10.1007/s00126-005-0027-5)

Kelson, C.R., Crowe, D.E., and Stein, H.J. (2005) Geochronology and geochemistry of the Hilltop, Lewis, and Bullion mining districts and surrounding area, Battle Mountain-Eureka trend, Nevada, *in* Rhoden, H.N., Steininger, R.C., and Vikre, P.G. (eds), *Geological Society of Nevada Symposium 2005*, p. 25-42.

Cannell, J., Cooke, D.R., Walshe, J.L., and Stein, H. (2005) Geology, mineralization, alteration, and structural evolution of the El Teniente porphyry Cu-Mo deposit: *Economic Geology*, v. 100, no. 5, p. 979-1003. (https://doi.org/10.2113/gsecongeo.102.6.1171)

Wanhainen, C., Billström, K., Martinsson, O., Stein, H., and Nordin, R. (2005) 160 m.y. of magmatic/hydrothermal and metamorphic activity in the Gällivare area: Re-Os dating of molybdenite and U-Pb dating of titanite from the Aitik Cu-Au-Ag deposit, northern Sweden: *Mineralium Deposita*, v. 40, p. 435-447. (https://doi.org/10.1007/s00126-005-0006-x)

Lundmark, C. Stein, H., and Weihed, P. (2005) The geology and Re-Os geochronology of the Paleoproterozoic Vaikijaur Cu-Au-(Mo) porphyry style deposit in the Jokkmokk granitoid, northern Sweden: *Mineralium Deposita*, v.40, p. 396-408. (https://doi.org/10.1007/s00126-005-0003-0)

Kohút, M. and Stein, H (2005) Re-Os molybdenite dating of granite-related Sn-W-Mo mineralisation at Hnilec, Gemeric Superunit, Slovakia: *Mineralogy and Petrology*, v. 85, p. 117-129. (https://doi.org/10.1007/s00710-005-0082-8)

Hegardt, E.A., Cornell, D., Claesson, L., Simakov, S., Stein, H., and Hannah, J. (2005) Eclogites in the central part of the Sveconorwegian Eastern Segment of the Baltic Shield: support for an extensive eclogite terrane: *GFF*, v. 127, pt. 3, p. 221-232. (http://dx.doi.org/10.1080/11035890501273221)

Brooks, K., Tegner, C., Stein, H., and Thomassen, B. (2004) Re-Os and $^{40}Ar/^{39}Ar$ ages of porphyry molybdenum deposits in the East Greenland volcanic-rifted margin: *Economic Geology*, v. 99, no. 6, p. 1215-1222. (https://doi.org/10.2113/gsecongeo.99.6.1215)

Bucci, L.A., NcNaughton, N.J., Fletcher, I.R., Groves, D.I., Kositcin, N., Stein, H.J., and Hagemann, S.G. (2004) Timing and duration of high-temperature gold mineralization and spatially associated granitoid magmatism at Chalice, Yilgarn craton, Western Australia: *Economic Geology*, v. 99, no. 6, p. 1123-1144. (https://doi.org/10.2113/gsecongeo.99.6.1123)

Stein, H.J., Hannah, J.L., Zimmerman, A., Markey, R., Sarkar, S.C., and Pal, A.B. (2004) A 2.5 Ga porphyry Cu-Mo-Au deposit at Malanjkhand, central India: implications for Late Archean continental assembly: *Precambrian Research*, v. 134, no. 3-4, p. 189-226. (https://doi.org/10.1016/j.precamres.2004.05.012)

Du, A., Wu, S., Sun, D., Wang, S., Qu, W., Markey, R., Stein, H., Morgan, J., and Malinovskiy, D. (2004) Preparation and certification of Re-Os dating reference materials: molybdenites HLP and JDC: *Geostandards and Geoanalytical Research*, v. 28, no. 1, p. 41-52. (https://doi.org/10.1111/j.1751-908X.2004.tb01042.x)

Doebrich, J.L., Zahony, S.G., Leavitt, J.D., Portacio, J.S., Jr., Siddiqui, A.A., Wooden, J.L., Fleck, R.J., and Stein, H.J. (2004) Ad Duwayhi, Saudi Arabia: geology and geochronology of a Neoproterozoic intrusion-related gold system in the Arabian shield: *Economic Geology*, v. 99, p. 713-741. (https://doi.org/10.2113/99.4.713)

Hannah, J.L., Bekker, A., Stein, H.J., Markey, R.J., and Holland, H.D. (2004) Primitive Os and 2316 Ma age for marine shale: implications for Paleoproterozoic glacial events and the rise of atmospheric oxygen: *Earth and Planetary Science Letters*, v. 225, p. 43-52. (https://doi.org/10.1016/j.epsl.2004.06.013)

Langthaler, K.J., Raith, J.G., Cornell, D.H., Stein, H.J., and Melcher, F. (2004) Molybdenum mineralization at Alpeiner Scharte, Tyrol (Austria): results of in-situ U-Pb zircon and Re-Os molybdenite dating: *Mineralogy and Petrology*, v. 82, p. 33-64. (https://doi.org/10.1007/s00710-004-0048-2)

Mao, J., Stein, H., Du, A., Zhou, T., Mei, Y., Li, Y., Zang, W., and Li, J. (2004) Molybdenite Re-Os precise dating for molybdenite from Cu-Au-Mo deposits in the Middle-Lower reaches of Yangtze River Belt and its implications for mineralization: *Acta Geologica Sinica*, v. 78, no. 1, p. 121-131.

Bekker, A., Holland, H.D., Wang, P.-L., Rumble, D. III, Stein, H.J., Hannah, J.L., Coetzee, L.L., and Beukes, N.J. (2004) Dating the rise of atmospheric oxygen: *Nature*, v. 427, no. 8, p. 117-120. (https://doi.org/10.1038/nature02260)

Sims, P.K. and Stein, H.J. (2003) Tectonic evolution of the Proterozoic Colorado province, Southern Rocky Mountains: a summary and appraisal: *Rocky Mountain Geology*, v. 38, no. 2, p. 183-204. (https://doi.org/10.2113/gsrocky.38.2.183)

Requia, K., Stein, H., Fontboté, L., and Chiaradia, M. (2003) Re-Os and Pb-Pb geochronology of the Archean Salobo iron oxide copper-gold deposit, Carajás mineral province, northern Brazil: *Mineralium Deposita*, v. 38, no. 6, p. 727-738. (https://doi.org/10.1007/s00126-003-0364-1)

Markey, R.J., Hannah, J.L., Morgan, J.W., and Stein, H.J. (2003) A double spike for osmium analysis of highly radiogenic samples: *Chemical Geology*, v. 200, p. 395-406. (https://doi.org/10.1016/S0009-2541(03)00197-9)

Stein, H., Scherstén, A., Hannah, J., and Markey, R. (2003) Sub-grain scale decoupling of Re and ^{187}Os and assessment of laser ablation ICP-MS spot dating in molybdenite: *Geochimica et Cosmochimica Acta*, v. 67, no. 19, p. 3673-3686. (https://doi.org/10.1016/S0016-7037(03)00269-2)

Bingen, B. and Stein, H. (2003) Molybdenite Re-Os dating of biotite dehydration melting in the Rogaland high-temperature granulites, S Norway: *Earth and Planetary Science Letters*, v. 208, no. 3-4, p. 181-195. (https://doi.org/10.1016/S0012-821X(03)00036-0)

Ishihara, S., Stein, H.J., and Tanaka, R. (2002) Re-Os age of molybdenite from the Busetsu two-mica granite, central Japan: *Bulletin of the Geological Survey of Japan*, v. 53, no. 5/6, p. 479-482. (http://doi.org/10.9795/bullgsj.53.479)

Wiszniewska, J., Claesson, S., Stein, H., Vander Auwera, J., and Duchesne, J.-C. (2002) The north-eastern Polish anorthosite massifs: petrological, geochemical and isotopic evidence for a crustal derivation: *Terra Nova*, v. 14, p. 451-460. (https://doi.org/10.1046/j.1365-3121.2002.00443.x)

Stein, H.J. and Bingen, B. (2002) 1.05-1.01 Ga Sveconorwegian metamorphism and deformation of the supracrustal sequence at Sæsvatn, south Norway: Re-Os dating of Cu-Mo mineral occurrences, in Blundell, D., Neubauer F., & von Quadt, A. (eds.), The Timing and Location of Major Ore Deposits in an Evolving Orogen: *Geological Society, London, Special Publications*, 204, p. 319-335. (https://doi.org/10.1144/GSL.SP.2002.204.01.18)

Sims, P.K., Stein, H.J., and Finn, C.A. (2002) New Mexico structural zone – an analogue of the Colorado mineral belt: *Ore Geology Review*, v. 21, p. 211-225. (https://doi.org/10.1016/S0169-1368(02)00090-2)

Bingen, B., Mansfeld, J., Sigmond, E.M.O., and Stein, H. (2002) Baltica-Laurentia link during the Mesoproterozoic: 1.27 Ga development of continental basins in the Sveconorwegian orogen, southern Norway: *Canadian Journal of Earth Sciences*, v. 39, p. 1425-1440. (https://doi.org/10.1139/e02-054)

Ciobanu, C.L., Cook, N.J., and Stein, H.J. (2002) Regional setting and geochronology of the Late Cretaceous Banatitic magmatic and metallogenic belt: *Mineralium Deposita*, v. 37, p. 541-567. (https://doi.org/10.1007/s00126-002-0272-9)

Brown, S.M., Fletcher, I.R., Stein, H.J., Snee, L.W., and Groves, D.I. (2002) Geochronological constraints on pre-, syn-, and post-mineralization events at the world-class Cleo gold deposit, Eastern Goldfields province, western Australia: *Economic Geology*, v. 97, p. 541-559. (https://doi.org/10.2113/gsecongeo.97.3.541)

Hannah, J.L. and Stein, H.J. (2002) Re-Os model for the origin of sulfide deposits in anorthosite-associated intrusive complexes: *Economic Geology*, v. 97, no. 2, p. 371-383. (https://doi.org/10.2113/gsecongeo.97.2.371)

Scherstén, A. (2002) ^{187}Re-^{187}Os evidence for crustal lenses of Svecofennian age within the Mylonite Zone, SW Sweden: *GFF*, v. 124, p. 35-39. (http://dx.doi.org/10.1080/11035890201241035)

Stein, H.J., Markey, R.J., Morgan, J.W., Hannah, J.L., and Scherstén, A. (2001) The remarkable Re-Os chronometer in molybdenite: how and why it works: *Terra Nova*, v. 13, no. 6, p. 479-486. (https://doi.org/10.1046/j.1365-3121.2001.00395.x)

Arne, D., Bierlein, F., Morgan, J.W., and Stein, H.J. (2001) Re-Os dating of sulfides associated with gold mineralization in central Victoria, Australia: *Economic Geology*, v. 96, p. 1455-1459. (https://doi.org/10.2113/gsecongeo.96.6.1455)

Zachariáš, J., Pertold, Z., Pudilová, M., Zák, K., Pertoldová, J., Stein, H., and Markey, R. (2001) Geology and genesis of Variscan porphyry-style gold mineralization, Petráčkova hora deposit, Bohemian Massif, Czech Republic: *Mineralium Deposita*, v. 36, p. 517-541. (https://doi.org/10.1007/s001260100187)

Stein, H.J., Morgan, J.W., and Scherstén, A. (2000) Re-Os dating of low-level highly-radiogenic (LLHR) sulfides: the Harnäs gold deposit, southwest Sweden records continental scale tectonic events: *Economic Geology*, v. 95, no. 8, p. 1657-1671. (https://doi.org/10.2113/gsecongeo.95.8.1657)

Watanabe, Y. and Stein, H.J. (2000) Re-Os ages for the Erdenet and Tsagaan Suvarga porphyry Cu-Mo deposits, Mongolia, and tectonic implications: *Economic Geology*, v. 95, no. 7, p. 1537-1542. (https://doi.org/10.2113/gsecongeo.95.7.1537)

Raith, J.G. and Stein, H.J. (2000) Re-Os dating and sulfur isotope composition of molybdenite from tungsten deposits in western Namaqualand, South Africa: Implications for ore genesis and the timing of metamorphism: *Mineralium Deposita*, v. 35, no. 8, p. 741-753. (https://doi.org/10.1007/s001260050276)

Torrealday, H.I., Hitzman, M.W., Stein, H.J., Markey, R.J., Armstrong, R., and Broughton, D. (2000) Re-Os and U-Pb dating of the vein-hosted mineralization at the Kansanshi copper deposit, northern Zambia: *Economic Geology*, v. 95, no. 5, p. 1165-1170. (https://doi.org/10.2113/gsecongeo.95.5.1165)

Morgan, J.W., Stein, H.J., Hannah, J.L., Markey, R.J., Wiszniewska, J. (2000) Re-Os study of ores from the Suwalki anorthosite massif, northeast Poland: *Mineralium Deposita*, v. 35, p. 391-401. (https://doi.org/10.1007/s001260050251)

Hofstra, A.H., Snee, L.W., Rye, R.O., Folger, H.W., Phinisey, J.D., Loranger, R.J., Dahl, A.R., Naeser, C.W., Stein, H.J., and Lewchuk, M. (1999) Age constraints on Jerritt Canyon and other Carlin-type gold deposits in the western United States – Relationship to Mid-Tertiary Extension and Magmatism: *Economic Geology*, v. 94, no. 6, p. 769-802. (https://doi.org/10.2113/gsecongeo.94.6.769)

Stein, H.J., Sundblad, K., Markey, R.J., Morgan, J.W., and Motuza, G. (1998) Re-Os ages for Archaean molybdenite and pyrite, Kuittila-Kivisuo, Finland and Proterozoic molybdenite, Kabeliai, Lithuania: Testing the chronometer in a metamorphic and metasomatic setting: *Mineralium Deposita*, v. 33, no. 4, p. 329-345. [Received the 1999 Mineralium Deposita Best Paper Award] (https://doi.org/10.1007/s001260050153)

Stein, H.J., Morgan, J.W., Markey, R.J., and Hannah, J.L. (1998) An introduction to Re-Os: What's in it for the mineral industry?: *SEG Newsletter* (feature article), January 1998, no. 32, p. 1, 8-15.

Markey, R.J., Stein, H.J., and Morgan, J.W. (1998) Highly precise Re-Os dating of molybdenite using alkaline fusion and NTIMS: *Talanta*, v. 45, p. 935-946. (https://doi.org/10.1016/S0039-9140(97)00198-7)

Stein, H.J., Markey, R.J., Morgan, J.W., Du, A., and Sun, Y. (1997) Highly precise and accurate Re-Os ages for molybdenite from the East Qinling molybdenum belt, Shaanxi Province, China: *Economic Geology*, v. 92, no. 7/8, p. 827-835. (https://doi.org/10.2113/gsecongeo.92.7-8.827)

Stein, H.J. and Cathles, L.M., editors, (1997) The timing and duration of hydrothermal events: *Economic Geology*, v. 92, no. 7/8. p. 763-765. (https://doi.org/10.2113/gsecongeo.92.7-8.763)

Extended Abstracts and Short Papers in Proceedings/Symposium Volumes:

Stewart, P.W., Stein, H.J., and Roa, K. (2017) Fruta del Norte, Ecuador: a completely preserved Late Jurassic epithermal gold-silver deposit: submitted, SGA, 14th Biennial Meeting, Québec City, August 20-23, 2017.

Mikulski, S.Z. and Stein, H.J. (2015) Re-Os ages for Ag-bearing Cu sulphide ores from the Kupferschiefer in Poland, *in* André-Mayer et al (editors), Mineral Resources in a Sustainable World, Proceedings Volume 2, 13th Biennial SGA Meeting, p. 607-610.

Stein, H.J. and Hannah, J.L. (2014) The emerging potential of Re-Os isotope geochemistry for source rocks and maturation-migration histories: *International Petroleum Technology Conference (IPTC)*, Doha, Qatar, 20-22 January 2014, 5 pgs, 2 figs. [IPTC Paper 17693-MS]

Hannah, J.L., Stein, H.J., Xu, G., Galimberti, R., and Nali, M. (2014) Age and composition of source rocks: new steps toward tracking hydrocarbon migration: *International Petroleum Technology Conference (IPTC)*, Doha, Qatar, 20-22 January 2014, 4 pgs, 3 figs. [IPTC Paper 17600-MS]

Stein, H.J., Hannah, J.L., Yang, G., Galimberti, R., and Nali, M. (2014) Ordovician source rocks and Devonian oil expulsion on bolide impact at Siljan, Sweden – the Re-Os story: *International Petroleum Technology Conference* (IPTC), Doha, Qatar, 20-22 January 2014, 6 pgs, 4 figs. [IPTC Paper 17601-MS]

Georgiev, S., Stein, H., and Hannah, J. (2013) Correlation of Permo-Triassic sections in Eastern Greenland and Western Canada based on Re-Os and stable isotope data: First joint GSC-GSA Meeting, Chengdu, *Acta Geologica Sinica* (English edition), v. 87 (supplement), p. 920-922.

Xu, G., Hannah, J.L., Stein, H.J., and Georgiev, S. (2013) Application of Re-Os geochemistry to sedimentary basins: stratigraphic correlation oil – source correlation and paleo-environmental condition: First joint GSC-GSA Meeting, Chengdu, *Acta Geologica Sinica* (English Edition), v. 87 (supplement), p. 602-604.

Torgersen, E., Viola, G., Sandstad, J.S., and Stein, H.J. (2013) Structural constraints of the formation of copper-rich mesothermal vein deposits in the Repparfjord tectonic window, northern Norway: *12th SGA Biennial Meeting 2013, Proceedings Volume*, v. 3, p. 1323-1326.

Mikulski, S.Z. and Stein, H.J. (2013) Re-Os ages for sulphides from the (gold)-polymetallic deposits in the eastern metamorphic cover of the Karkonosze massif (SW Poland): *12th SGA Biennial Meeting 2013, Proceedings Volume*, v. 1, p. 217-220.

Duncan, R., Stein, H., Hitzman, M., and Nelson, E. (2013) Age constraints on the Merlin molybdenum-rhenium deposit, Cloncurry district, Queensland, Australia: are we dealing with a unique addition to the IOCG family?: *12th SGA Biennial Meeting 2013, Proceedings Volume*, v. 3, p. 1359-1362.

Jones, M., Cudahy, T., Laukamp, C., Stein, H., and Leahey, T. (2011) Cu-Au-Mo-Re-(U) mineral systems – New insights from Kalman: Digging Deeper 9 Seminar, Queensland Geological Record 2011/09, p. 67-70.

Mikulski, S.Z. and Stein, H.J. (2011) Re-Os ages for molybdenites from the Variscan Karkonosze massif and its eastern metamorphic cover (SW Poland): 11th SGA biennial meeting, Antofagasta, Chile, p. 130-132.

Duncan, R., Hitzman, M., Lopez, G., Ramos, J., Duran, E., Cruise, M., and Stein, H. (2011) The San Fernando prospect, Baja California, México: a cousin to Andean iron oxide-copper-gold systems?: 11th SGA biennial meeting, Antofagasta, Chile, p. 503-505.

Duncan, R.J., Hitzman, M., Nelson, E., Stein, H., and Kirwin, D. (2009) Re-Os molybdenite ages for the Southern Cloncurry IOCG district, Queensland, Australia: protracted mineralisation over 210 myr, *in* Williams, P.J., Rusk, B., and Oliver, N. (eds), "Smart Science for Exploration and Mining", *Proceedings of the Tenth Biennial SGA Meeting*, Townsville, Australia, p. 626-628.

Khin Zaw, Meffre, S., Kamvong, T., Khositanont, S., Stein, H., Vasconcelos, P. Golding, S. (2009) Geochronological and metallogenic framework of Cu-Au skarn deposits along the Loei fold belt, Thailand and Lao PDR: *in* Williams, P.J., Rusk, B., and Oliver, N. (eds), Smart Science for Exploration and Mining, *Proceedings of the Tenth Biennial SGA Meeting*, Townsville, Australia, p. 309-311.

Bingen, B. and Stein, H.J. (2007) Fra gruvedrift til geoturisme: *GEO Magasin for Geomiljøet*, no. 4 (Juni), p. 24-25.

Bingen, B. and Stein, H.J. (2007) Nye aldersdateringer forteller den geologiske historien: *GEO Magasin for Geomiljøet*, no. 4 (Juni), p. 26-28.

Mikulski, S.Z., Stein, H.J., and Zimmerman, A. (2007) Re-Os ages for molybdenites from the Variscan Strzegom-Sobótka granite massif (SW Poland): *in* Andrews, C.J et al. (eds), *Digging Deeper*, Irish Association for Economic Geology, v. 1, p. 361-364.

Oberthür, T., Melcher, F., Henjes-Kunst, F., Stein, H., Zimmerman, A., Gerdes, A., and El Ghorfi, M. (2007) Evidence for a Hercynian age for cobalt-arsenide-(gold) mineralization, Bou Azzer, Anti-Atlas, Morocco from new U-Pb, Sm-Nd and Re-Os age determinations: *in* Andrews, C.J et al. (eds), *Digging Deeper*, Irish Association for Economic Geology, v. 1, p. 357-360.

Carriedo, J., Tornos, F., Velasco, F., and Stein, H. (2007) Complex structural and hydrothermal evolution of the Cala magnetite deposit, SW Iberia – an ICOG deposit?: *in* Andrews, C.J et al. (eds), *Digging Deeper*, Irish Association for Economic Geology, v. 2, p. 1351-1354.

Vallance, J., Fontboté, L., Markowski, A., Vennemann, T., Stein, H.J., Schaltegger, U., and Chiaradia, M. (2006) Hydrothermal fluid evolution and age of the Nambija oxidized gold skarn (Ecuador): *TRANSMET (Transport, dépôt, et dispersion naturelle des métaux)* meeting, Nancy, France, 6-7 July 2006.

Mironov, A. and Stein, H., Zimmerman, A., and Yang, G. (2006) Re-Os dating of the Orekitkan molybdenum deposit (Russia), *in* Cherkasov, S. (editor), extended abstracts of the 12th Quadrennial IAGOD Symposium, "Understanding the genesis of ore deposits to meet the demand of the 21st century", 21-24 August 2006, Moscow, Russia, (CD-ROM Abstract #065, Program and Short Abstracts, p. 22).

Bjerkgård, T., Stein, H., Sandstad, J.S., Bingen, B., and Moniz, A. (2006) Gold mineralization in the Txitonga group, Niassa province, Mozambique, at the latest Cambrian: *21st Colloquium of African Geology (CAG)*, July 2-5, Maputo, Mozambique.

Dilles, J.H., Field C.W., Houston, R.A., Kent, A.J.R., Zhang, L., Reed, M.H., Rusk, B.G., Miller, B., Martin, M.W., Rye R.O., Snee, L.W., and Stein, H.J. (2006) Lessons from Butte, Montana: exploration and mining applications from recent research: *Society of Economic Geologists (SEG) Meeting*, May 14-16, Keystone, Colorado.

Zimmerman, A., Stein, H., Hannah, J., Berza, T., and Kozelj, D. (2006) Linking metallogeny and tectonics along the Balkan-Carpathian orogen by Re-Os molybdenite dating: *SEG Conference*, Keystone, Colorado, May 14-16, 2006.

Braxton, D., Cooke, D., Dunlap, J., Norman, M., Reiners, P., Stein, H., and Waters, P. (2006) Constraining the timing of hypogene mineralization and supergene oxidation at the Boyongan and Bayugo porphyry Cu-Au deposits, Mindanao, Philippines: *SEG Conference*, Keystone, Colorado, May 14-16, 2006.

Mikulski, S.Z., Stein, H.J., and Markey, R.J. (2005) Determinations of sulfide ages from Lower Silesia using the Re-Os method: *Mineralogical Society of Poland, Special Papers*, v. 26, p. 215-218.

Bierlein, F.P., Coira, B., and Stein, H. (2005) Geochemical and isotopic constraints on Palaeozoic orogenic gold endowment and crustal evolution of the south central Andes, NW Argentina: *in* Mao, J. and Bierlein, F.P. (eds), *Mineral Deposit Research: Meeting the Global Challenge*, Springer, Berlin, p. 521-524.

Mikulski, S.Z. and Stein, H.J. (2005) Re-Os age for molybdenite from the Variscan Strzegom-Sobótka massif, SW Poland: *in* Mao, J. and Bierlein, F.P. (eds), *Mineral Deposit Research: Meeting the Global Challenge*, Springer, Berlin, p. 789-792.

Mikulski, S.Z., Markey, R.J., and Stein, H.J. (2005) Re-Os ages for auriferous sulfides from the gold deposits in the Kaczawa Mountains (SW Poland): *in* Mao, J. and Bierlein, F.P. (eds), *Mineral Deposit Research: Meeting the Global Challenge*, Springer, Berlin, p. 793-796.

Mironov, A.G., Stein, H., Zimmerman, A., and Zhmodik, S.M. (2005) Dating of gold occurrences in the Sayan-Baikal fold belt, southern Siberia, Russia: *in* Mao, J. and Bierlein, F.P. (eds), *Mineral Deposit Research: Meeting the Global Challenge*, Springer, Berlin, p. 797-799.

Stein, H.J., Markowiak, M., and Mikulski, S.Z. (2005) Metamorphic to magmatic transition captured at the Myszków Mo-W deposit, southern Poland: *in* Mao, J. and Bierlein, F.P. (eds), *Mineral Deposit Research: Meeting the Global Challenge, Springer*, Berlin, p. 833-836.

Murakami, H., Watanabe, Y., and Stein, H. (2005) Re-Os ages of molybdenite from the Tepeoba breccia-centered Cu-Mo-Au deposit, western Turkey: brecciation triggered mineralization: *in* Mao, J. and Bierlein, F.P. (eds), *Mineral Deposit Research: Meeting the Global Challenge*, Springer, Berlin, p. 805-808.

Kohút, M., Stein, H.J., and Radvanec, M. (2004) Re-Os dating of molybdenite from the Hnilec Permian granite-related mineralization – its tectonic significance (Gemeric Unit, Slovakia): *Proceedings, Central European Tectonic Structure Group (CETEG)*, GeoLines, v. 17, p. 54-55.

Stein, H.J., Hannah, J.L., Morgan, J.W., and Scherstén, A. (2003) Parallel Re-Os isochrons and high $^{187}Os/^{188}Os$ initial ratios: constraints on the origin of sulfide-bearing anorthosite systems: *in*

Duchesne, J.-C. and Korneliussen, A. (editors), Ilmenite Deposits and Their Geological Environment: *Norges Geologiske Undersøkelse*, Special Publication No. 9, p. 47-50.

Bingen, B. and Stein, H. (2003) Re-Os dating of the Ørsdalen W-Mo district in Rogaland, S Norway, and its relationship to Sveconorwegian high-grade metamorphic events: *in* Duchesne, J.-C. and Korneliussen, A. (editors), Ilmenite Deposits and Their Geological Environment: *Norges Geologiske Undersøkelse*, Special Publication No. 9, p. 55-57.

Hannah, J.L. and Stein, H.J. (2003) Evidence from Re-Os for the origin of sulphide concentrations in anorthosites: *in* Duchesne, J.-C. and Korneliussen, A. (editors), Ilmenite Deposits and Their Geological Environment: *Norges Geologiske Undersøkelse*, Special Publication No. 9, p. 42-45.

Raith, J. G., Stein, H., and Kempe, U. (2003) Lumineszenz-Untersuchungen an Scheelit und Re-Os Datierung von Molybdänit aus der Scheelitlagerstätte Felbertal: *Mitteilungen der Österreichischen Mineralogischen Gesellschaft*, v. 148, p. 261-263.

Stein, H.J., Markey, R.J., and Zimmerman, A. (2003) Molybdenite and metamorphism in northern (Norrbotten) Sweden: evaluation of economic potential using the Re-Os chronometer: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 1111-1114.

Hannah, J.L. and Stein, H.J. (2003) Re-Os systematics in syn-sedimentary/diagenetic pyrite: precise ages and Os cycling: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 81-84.

Markey, R.J. and Stein, H.J. (2003) Dating young molybdenites: a primer: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 1001-1004.

Cannell, J., Cooke, D.R., Stein, H.J., and Markey, R.J. (2003) New paragenetically constrained Re-Os molybdenite ages for El Teniente Cu-Mo porphyry deposit, central Chile: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 255-258.

Drábek, M. and Stein, H. (2003) The age of formation of a marble in the Moldanubian Varied Group, Bohemian massif, Czech Republic, using Re-Os dating of molybdenite: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 973-976.

Langthaler, K.J., Raith, J.G., Cornell, D.H., Stein, H.J., Markey, R., Melcher, F. (2003) Late Variscan Mo deposits of granitic origin – a metamorphosed example from the western Tauern Window, Austria: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 311-313.

Boni, M., Stein, H.J., Zimmerman, A., and Villa, I.M. (2003) Re-Os age for molybdenite from SW Sardinia (Italy): a comparison with $^{40}Ar/^{39}Ar$ dating of Variscan granitoids: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 247-250.

Berzina, A.P., Stein, H.J., Zimmerman, A., and Sotnikov, V.I. (2003) Re-Os ages for molybdenite from porphyry Cu-Mo and griesen Mo-W deposits of southern Siberia (Russia) preserve metallogenic record: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 231-234.

Mao, J.W., Du, A.D., Stein, H.J., Wu, G.G., Li, Y.F., and Zang, W.S. (2003) Re-Os dating of porphyry-skarn-stratabound Cu-Au-Mo deposits in the Middle-Lower Yangtze River metallogenic belt, China: implications for their genesis: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 323-326.

Zimmerman, A., Stein, H., Markey, R., Fanger, L., Heinrich, C., von Quadt, A., and Peytcheva, I. (2003) Re-Os ages for the Elatsite Cu-Au deposit, Srednogorie zone, Bulgaria: *in* Eliopoulos, D.G. et al. (eds), *Mineral Exploration and Sustainable Development*, Millpress, Rotterdam, p. 1253-1256.

Witt, W.K., Stein, H., and Cassidy, K.F. (2002) Leonora gold camp: 2.75 Ga gold mineralization overprinted by a 2.66-2.64 Ga orogeny: *Bulletin – Australian Institute of Geoscientists*, v. 36, p. 237-240.

Raith, J.G., Stein, H.J., Cornell, D.H., and Langthaler, K. (2002) Re-Os and U-Pb age constraints for W and Mo deposits in the Tauern Window: *Erdwissenschaften in Österreich 2002* (Pangeo Austria I) 28-30 June, Salzburg.

Stein, H.J. (2001) Re-Os dating of molybdenite, Coxey deposit, Red Mountain, B.C., Appendix 7 *in* Høy, T., Dunne, K.P.E., Metallogeny and Mineral Deposits of the Nelson-Rossland Map Area: Part II: The Early Jurassic Rossland Group, Southeastern British Columbia: *British Columbia Ministry of Energy and Mines*, Bulletin 109, 195 p.

Stein, H.J., Markey, R.J., Morgan, J.W., Selby, D., Creaser, R.A., McCuaig, T.C., and Behn, M. (2001) Re-Os dating of Boddington molybdenites, SW Yilgarn: two Au mineralization events: *AGSO-Geoscience Australia*, Record 2001/37, p. 469-471.

McCuaig, T.C., Behn, M., Stein, H.J., Hagemann, S.G., McNaughton, N., Cassidy, K.F., Champion, D., and Wyborn, L. (2001) The Boddington gold mine: a new style of Archaean Au-Cu deposit: *AGSO-Geoscience Australia*, Record 2001/37, p. 453-455.

Stein, H.J., Markey, R.J., Morgan, J.W., Hannah, J.L., and Scherstén, A. (2001) The remarkable Re-Os chronometer in molybdenite: how and why it works (with a comparative look at the Lobash Mo deposit, Russia), *in* Piestrzyński et al. (eds), *Mineral Deposits at the Beginning of the 21st Century*, Swets & Zeitlinger Publishers Lisse, p. 1099-1102.

Zachariáš, J. and Stein, H.J. (2001) Re-Os ages of Variscan hydrothermal gold mineralizations, Central Bohemian metallogenetic zone, Czech Republic, *in* Piestrzyński et al. (eds), *Mineral Deposits at the Beginning of the 21st Century*, Swets & Zeitlinger Publishers Lisse, p. 851-854.

Hannah, J.L. and Stein, H.J. (2001) Re-Os isotopic evidence for the origin of sulfide occurrences in anorthosite-dominated plutonic suites, *in* Piestrzyński et al. (eds), *Mineral Deposits at the Beginning of the 21st Century*, Swets & Zeitlinger Publishers Lisse, p. 587-590.

Wiszniewska, J. Duchesne, J.-C., Stein, H.J., and Jedrysek, M.O. (2001) Petrologic and isotopic evidence for crustal source of ore-bearing Suwalki anorthosites, Poland: *in* Piestrzyński et al. (eds): *Mineral Deposits at the Beginning of the 21st Century*, Swets & Zeitlinger Publishers Lisse, p. 635-638.

Stein, H.J., Hannah, J.L., Morgan, J.W., Scherstén, A., and Wiszniewska J (2001) Parallel Re-Os isochrons and high $^{187}Os/^{188}Os$ initial ratios: constraints on the origin of the Suwalki anorthosite massif, northeast Poland: *Ilmenite Deposits in the Rogaland Anorthosite Province, South Norway, NGU Report No. 2001.042*, p. 135-136.

Hannah, J.L. and Stein, H.J. (2001) Evidence from Re-Os for the origin of sulfide concentrations in anorthosites: *Ilmenite Deposits in the Rogaland Anorthosite Province, South Norway, NGU Report No. 2001.042*, p. 60-62.

Bingen, B. and Stein, H. (2001) Re-Os dating of the Ørsdalen W-Mo district in Rogaland, S Norway, and its relationship to Sveconorwegian high-grade metamorphism: *Ilmenite Deposits in the Rogaland Anorthosite Province, South Norway, NGU Report No. 2001.042*, p. 15-18.

Stein, H.J. (2001) The remarkable Re-Os chronometer in molybdenite: comparisons with U-Pb, Rb-Sr, K-Ar, and $^{40}Ar/^{39}Ar$ clocks in ore-forming environments: *2001 - A Hydrothermal Odyssey, Extended Conference Abstracts, 17-19th May, Townsville, Queensland, Australia, EGRU Contribution 59*, p. 189-190.

Gauthier, L., Hall, G., Stein, H., and Schaltegger, U. (2001) The Osborne deposit, Cloncurry district: a 1595 Ma Cu-Au skarn deposit: *2001 - A Hydrothermal Odyssey, Extended Conference Abstracts, 17-19th May, Townsville, Queensland, Australia, EGRU Contribution 59*, p. 58-59.

Rubenach, M., Adshead, N., Oliver, N., Tullemans, F., Esser, D., and Stein, H. (2001) The Osbourne Cu-Au deposit: geochronology and genesis of mineralization in relation to host albitites and ironstones: *2001 - A Hydrothermal Odyssey, Extended Conference Abstracts, 17-19th May, Townsville, Queensland, Australia, EGRU Contribution 59*, p. 172-173.

Raith, J.G., Stein, H.J., and Markey, R.J. (1999) Dating stratabound tungsten deposits with the Re-Os method – an example from western Namaqualand, South Africa, *in* Stanley, C.J., *et al* (eds.), *Mineral Deposits: Processes to Processing*, v. 2, Balkema, Rotterdam, p. 1283-1286.

Stein, H.J., Morgan, J.W., Markey, R.J., and Hannah, J.L. (1999) The status of the Re-Os chronometer for dating sulfides and oxides, *in* Stanley, C.J., *et al* (eds.), *Mineral Deposits: Processes to Processing*, v. 2, Balkema, Rotterdam, p. 1291-1294.

Torrealday, H.I., Hitzman, M.W., Stein, H.J., Markey, R.J., Armstrong, R., and Broughton, D. (1999) Re-Os and U-Pb dating of molybdenite and monazite from mineralized veins from the Kansanshi copper deposit, Zambia, *in* Stanley, C.J., *et al* (eds.), *Mineral Deposits: Processes to Processing*, v. 2, Balkema, Rotterdam, p. 1295-1297.

Stepanyuk, L.M., Bibikova, E.V., Claesson, S., Stein, H.J., Bogdanova, S.V., Skobelev, V.M. (1999) Geochronological and petrological evidence for far-field effects of 2.1-2.0 Ga convergent tectonics in the western Ukrainian shield: *Seventh Eurobridge Workshop* – Between EUROBRIDGE and TESZ, Abstract Volume, Polish Geological Institute, p. 80-82.

Wiszniewska, J., Duchesne, J-C., Claesson, S., Stein, H., and Morgan, J. (1999) Geochemical constraints on the origin of the Suwalki anorthosite massif and related Fe-Ti-V ores, NE Poland: *Seventh Eurobridge Workshop* – Between EUROBRIDGE and TESZ, Abstract Volume, Polish Geological Institute, p. 89-91.

Stein, H.J., Morgan, J.W., Markey, R.J., and Hannah, J.L. (1999) Re-Os dating of Au deposits in Precambrian terranes, *in* Cook, N.J. and Sundblad, K. (eds.), Precambrian gold in the Fennoscandian and Ukrainian Shields and related areas: *Au '99 Trondheim*, Norway, p. 144-147.

Stein, H.J., Sundblad, K., Markey, R.J., Sivoronov, A.A., Bobrov, A.A., Malyuk, B.I., and Pavlun, M.M. (1998) ^{187}Re-^{187}Os ages for molybdenites from the Maiske and Sergeevske Au deposits, Ukraine: *Geophysical Journal*, no. 4, p. 114-117.

Stein, H.J., Morgan, J.W., Markey, R.J., and Wiszniewska, J. (1998) A Re-Os study of the Suwalki anorthosite massif, northeast Poland: *Geophysical Journal*, no. 4, p. 111-114.

Stein, H.J., Markey, R.J., Morgan, J.W., Hannah, J.L., Zák, K., and Sundblad, K. (1997) Re-Os dating of shear-hosted Au deposits using molybdenite: *in* Papunen, H. (ed.), *Mineral Deposits: Research And Exploration -- Where Do They Meet?,* A.A. Balkema, Rotterdam, p. 313-317.

Markey, R.J., Stein, H.J., and Morgan, J.W. (1997) Highly precise Re-Os dating of molybdenite using alkaline fusion and NTIMS: *in* Papunen, H. (ed.), *Mineral Deposits: Research And Exploration -- Where Do They Meet?,* A.A. Balkema, Rotterdam, p. 957-960.

Stein, H.J., Markey, R.J., Morgan, J.W., Sundblad, K., and Larin, A. (1996) Re-Os dating of molybdenites from Pitkäranta, Russia reveals two temporally distinct periods of ore formation: A rapakivi granite mask on Late Svecofennian Mo-W ores: *7th International Symposium, Rapakivi Granites and Related Rocks,* Helsinki, p. 68-70.

Sundblad, K., Stein, H.J., Markey, R.J., Morgan, J.W., and Bergman, T. (1996) Re-Os age and geochemistry of highly-evolved granites associated with Mo and W ore deposits in Bergslagen, Sweden*: 7th International Symposium, Rapakivi Granites and Related Rocks*, Helsinki, p. 73-74.

Stein, H.J., Sundblad, K., Markey, R.J., and Morgan, J.W. (1995) Re-Os ages for Precambrian molybdenites from Kuittila, Finland and Kabeliai, Lithuania: *in* Pašava, J. Kríbek, B., and Zák, K. (eds.), *Mineral Deposits: From Their Origin to Their Environmental Impacts*: A.A. Balkema, Rotterdam, p. 525-530.

Hannah, J.L., Doolan, K.L., and Stein, H.J. (1995) Fluid evolution in the Mount Emmons porphyry molybdenum system, Colorado: from molybdenum stockwork to base-metal vein: *in* Pašava, J. Kríbek, B., and Zák, K. (eds), *Mineral Deposits: From Their Origin to Their Environmental Impacts*: A.A. Balkema, Rotterdam, p. 447-450.

Stein, H.J., Sundblad, K., Markey, R.J., Morgan, J.W., and Kouvo, O. (1995) New method for precise Re-Os dating reveals two generations of molybdenite at Mätäsvaara, Karelian Province of eastern Finland: *in* Glebovitsky, V.A. and Kotov, A.B. (eds.), *Precambrian of Europe: Stratigraphy, Structure, Evolution and Mineralization (MAEGS- 9),* abstract volume, sponsored by the Russian Academy of Sciences and Institute of Precambrian Geology and Geochronology, St. Petersburg, Russian Federation, p. 112-113.

Abstracts:

Stein, H.J. and Hannah, J.L. (2018) Fluids implicated in hydrocarbon migration: identifying the perpetrators in rifted margins: 2018 Conjugate Margins Conference (CMC), Halifax, Nova Scotia, August 19-22, 2019.

Hall, W.S., Stein, H.J., Kylander-Clark, A.R.C., Knight, C., Kuiper, Y.D., Enders, M.S., and Hitzman, M.W. (2018) Re-Os and U-Th-Pb age constraints on host rocks and mineralization events in the Kalahari Copperbelt, Botswana: SEG Conference, Keystone, CO, September 22-25, 2018.

Hurtig, N.C., Stein, H.J., Hannah, J.L., Hanley, J., Gysi, A.P., and Georgiev, S.V., (2018) The importance of hydrocarbon-water interaction in sedimentary-hosted ore deposits: SEG Conference, Keystone, CO, September 22-25, 2018.

Stein, H.J. and Hannah, J.L. (2018) Leap of faith between geochemistry and chemistry: *International Conference on Coordination Chemistry* (ICCC), Sendai, Japan, July 30 to August 4, 2018.

Yang, G., Zimmerman, A., Stein, H.J., and Hannah, J.L. (2018) Comment on recent study of Re and ^{187}Os decoupling in molybdenite using nanoscale technology: *Goldschmidt Conference*, Boston, August 12-17, 2018.

Georgiev, S.V., Stein, H.J., Hannah, J.L., Yang, G., Hurtig, N.C., Dons, C.E., Pedersen, J.H., and DiPrimio, R. (2018) Temporal evolution of the Brynhild petroleum system, North Sea: *Goldschmidt Conference*, Boston, August 12-17, 2018.

Hannah, J., Stein, H., Yang, G., Markey, R., Tohver, E., Kjøll, H.-J., Torsvik, T. (2018) Melt water surge at end Marinoan glaciation: Os isotopic evidence: *Goldschmidt Conference*, Boston, August 12-17, 2018.

Goswami, V., Stein, H., and Hannah, J. (2018) Re-Os geochemistry of cherts and chalks spanning the K-Pg, Stevns Klint, Denmark: *Goldschmidt Conference*, Boston, August 12-17, 2018.

Hurtig, N.C., Georgiev, S.V., Stein, H.J., and Hannah, J.L. (2018) Effect of water on oil and water chemistry on Re-Os partitioning during water-oil interaction: *Goldschmidt Conference*, Boston, August 12-17, 2018.

Stein, H.J., Goswami, V., and Hannah, J.L. (2018) The Re-Os record embracing the Cretaceous-Paleogene boundary at Stevns Klint, eastern Denmark: Geophysical Research Abstracts, v. 20, EGU2018-16488, EGU General Assembly, Vienna, April 8-13, 2018.

Stein, H.J. (2018) How long 'til we get there?: *Geophysical Research Abstracts*, v. 20, EGU2018-Invited, EGU general assembly, Vienna, April 8-13, 2018.

Stein, H.J. and Hannah, J.L. (2017) Deceased slabs drive oil: AGU meeting, New Orleans, December 11-15, 2017.

Hannah, J.L. and Stein, H.J. (2017) The Os seawater record: the good, the bad and the ugly: AGU meeting, New Orleans, December 11-15, 2017.

Goswami, V., Stein, H., and Hannah, J.L., Ahlberg, P. and Maletz, J. (2017) Graptolite graveyard: Re-Os dating of macroplankton at the Lower-Middle Ordovician juncture (Floian--Dapingian stage boundary), Tøyen Shale, Sweden, extends early Phanerozoic paired Os-Sr isotope record in seawater: AGU meeting, New Orleans, December 11-15, 2017.

Stein, H., Yang, G., Hannah, J., Georgiev, S. (2017) Bitumen – the zircon of petroleum systems: Goldschmidt Conference, Paris, August 13-18, 2017.

Hannah, J.L. and Stein, H.J. (2017) Dynamic models: time as a critical element in resource exploration: Goldschmidt Conference, Paris, August 13-18, 2017.

DiMarzio, J.M., Georgiev, S.V., Stein, H.J., and Hannah, J.L. (2017) Residency of Rhenium and Osmium in a heavy crude oil: Goldschmidt Conference, Paris, August 13-18, 2017.

Goswami, V., Stein, H., Hannah, J. (2017) Variation in $^{187}Os/^{188}Os$ across K-Pg boundary at Stevns Klint, Denmark: Goldschmidt Conference, Paris, August 13-18, 2017.

Hurtig, N.C., Stein, H.J., and Hannah, J.L. (2017) Re-Os systematics during water-oil interaction: Goldschmidt Conference, Paris, August 13-18, 2017.

Georgiev, S.V., Stein, H.J., Hannah, J.L. and Di Primio, R. (2017) Re-Os ages for a multi-oil petroleum system, Norwegian North Sea: Goldschmidt Conference, Paris, August 13-18, 2017.

Stein, H.J., Hannah, J.L., and Georgiev, S.V. (2017) Re-Os chronology reconstructs whole petroleum systems and interrogates an external fluid: AAPG/SEG ICE International Conference and Exhibition, London, October 15-18, 2017.

Hannah, J.L., DiMarzio, J., Hurtig, N.C., and Stein, H.J. (2017) Why Re-Os geochronology works for oils – experimental evidence: AAPG/SEG ICE International Conference and Exhibition, London, October 15-18, 2017.

Stein, H.J., Hannah, J.L. (2017) Whole petroleum systems reconstructed in absolute time using Re-Os isotope geochemistry: AAPG, Houston, TX, April 2-5, 2017.

DiMarzio, J.M., Georgiev, S.V., Stein, H.J., and Hannah, J.L. (2017) Residency of Re and Os within heavy crude oil: AAPG, Houston, TX, April 2-5, 2017.

Hannah, J.L. and Stein, H.J. (2017) Dating Oil – Success: Vinterkonferansen, Oslo, January 9-11, 2016.

Stein, H.J. and Hannah, J.L. (2017) Fifty Shades of Gray (and Black): Vinterkonferansen, Oslo, January 9-11, 2017.

Boraas-Connors, M., Hannah, J.L., and Stein, H.J. (2017) Using lithologic and chemostratigraphic variations to interpret Re-Os isochrons from organic-rich shales: The late Jurassic Agardhfjellet Formation, Svalbard, Norway: Houston Geological Society, "Mudrocks Conference", March 7-8, 2017.

Lawrence, C.J., Coleman, D.S., and Stein, H.J. (2016) Geochronology of the Thompson Creek Mo deposit: evidence for the formation of arc-related Mo deposits: American Geophysical Union (AGU), December 12-16, 2016, Abstract #145708.

Stein, H.J. and Hannah, J.L. (2016) Fifty shades of gray and black: SEPM Research Conference, Oceanic Anoxic Events (OAEs), Austin, Texas, USA, November 2-7, 2016.

Hannah, J.L. and Stein, H.J. (2016) New tricks for untangling OAEs – thoughts from the Re-Os lab: SEPM Research Conference, Oceanic Anoxic Events (OAEs), Austin, Texas, USA, November 2-7, 2016.

Hurtig, N.C., Stein, H.J., Hannah, J.L. (2016) Re-Os systematics at the water-oil interface from an experimental perspective: *Geological Society of America Abstracts with Programs*, v. 48, no. 7, doi: 10.1130/abs/2016AM-283562

DiMarzio, J.M., Georgiev, S.V., Stein, H.J., Hannah, J.L. (2016) Residence of rhenium and osmium (Re-Os) within asphaltene and maltene sub-fractions of a heavy crude oil: *Geological Society of America Abstracts with Programs*, v. 48, no. 7, doi: 10.1130/abs/2016AM-281621

Boraas-Connors, M., Hannah, J.L., Markey, R.J., and Stein, H.J. (2016) Paleoenvironmental insights from the $^{187}Os/^{188}Os$ parameter of the Re-Os geochronometer with an example from the late Jurassic Agardhfjellet Formation, Svalbard, Norway: *Geological Society of America Abstracts with Programs*, v. 48, no. 7, doi: 10.1130/abs/2016AM-287096

Hannah, J.L. and Stein, H.J. (2016) Fine-scale temporal variations in mudrocks: Re-Os and corroborating geochemical tools: *Geological Society of America Abstracts with Programs*, v. 48, no. 7, doi: 10.1130/abs/2016AM-287834 *(invited talk)*

Georgiev, S.V., Stein, H.J., and Hannah, J.L. (2016) Timing, duration, and causes for Late Jurassic-Early Cretaceous anoxia in the Barents Sea: Abstract, International Geologic Congress, Cape Town, South Africa, Paper No 5334.

Hannah, J.L., Georgiev, S.V., and Stein, H.J. (2016) Dissembling petroleum systems with Re-Os isotope geochemistry: Abstract, International Geologic Congress, Cape Town, South Africa, Paper No 5468.

Stein, H.J. and Hannah, J.L. (2016) Twenty years on – Re-Os revolution for crustal rocks: Abstract, International Geologic Congress, Capetown, South Africa, Paper No 5469.

DiMarzio, J.M., Georgiev, S.V., Stein, H., and Hannah, J. (2016) Effect of precipitation of asphaltenes on Re-Os isotopic ratios: AAPG Annual Conference and Exhibition, Abstract 2383033 [Received the AAPG 2016 Jules Braunstein Memorial Award]

Connors, M.B., Markey, R., Hannah, J., and Stein, H. (2016) Identifying causes of disturbances in the Re-Os geochronometer in black shales: a case from the Jurassic Agardhfjellet Formation, Svalbard: AAPG Annual Conference and Exhibition, Abstract 2380137.

Hannah, J. and Stein, H. (2016) Re-Os systematics in petroleum systems – what are we measuring: AAPG Annual Conference and Exhibition, Abstract 2380833.

Stein, H.J. and Hannah, J.L. (2016) A gallery of oil components – their metals and Re-Os signatures: *Geophysical Research Abstracts*, v. 18, EGU2016-16623.

Stein, H.J. (2016) Uplift record in hydrocarbons and sulphides in south Norway: 32nd Nordic Geological Winter Meeting, special volume of *Bulletin of the Geological Society of Finland*, p. 257.

Hannah, J.L. and Stein, H.J. (2016) Re-Os and U-Pb geochronology – complementary systems: 32nd Nordic Geological Winter Meeting, special volume of *Bulletin of the Geological Society of Finland*, p. 170-171.

Molnár, F., Stein, H., O'Brien, H., Cook, N., Pohjolainen, E., Pakkanen, L., and Johanson, B. (2016) Re-Os and U-Pb geochronology of the Au-U mineralization at Rompas, Peräpohja schist belt, northern Finland: 32nd Nordic Geological Winter Meeting, special volume of *Bulletin of the Geological Society of Finland*, p. 125-126.

Yang, S.H., Yang, G., Qu, W.J., Du, A.D., Hanski, E., and Chen, J.F. (2016) Pt-Os geochronology constraints on a Cu-Pt-rich ore body in the Jinchuan intrusion, China: dating hydrothermal overprinting and the final emplacement of the deposit: 32nd Nordic Geological Winter Meeting, special volume of *Bulletin of the Geological Society of Finland*, p. 226-227.

Lu, X., Kendall, B., Li, C., Stein, H.J., Hannah, J.L., Gordon, G.W., Ebbestad, J.-O. (2015) Reconstruction of local and global marine redox conditions during deposition of late Ordovician and early Silurian organic-rich mudrocks in the Siljan Ring District, central Sweden: *Geological Society of America Abstracts with Programs*, v. 47, no 7, p. 698.

Pollard, P.J., Smillie, R.W., Stein, H.J., and Hastings, D.R. (2015) High-precision Re-Os molybdenite ages for porphyry- and skarn-style Cu-Au mineralization at Ok Tedi, Papua New Guinea: World Class Ore Deposits – Discovery to Recovery: SEG 2015 Conference, Hobart, Tasmania, Australia, September 27-30, 2015 [https://www.segweb.org/SEG/Events/SEG_Conference_Website_Archives/SEG/_Events/SEG_Conference_Website_Archives.aspx]

Cook, N., Molnár, F., and Stein, H. (2015) Lightning strikes twice – Gold-uraninite mineralization at the Rompas prospect in Arctic Finland: World Class Ore Deposits – Discovery to Recovery: SEG 2015 Conference, Hobart, Tasmania, Australia, September 27-30, 2015 [https://www.segweb.org/SEG/Events/SEG_Conference_Website_Archives/SEG/_Events/SEG_Conference_Website_Archives.aspx]

Molnár, F., Stein, H., Cook, N., and O'Brien, H. (2015) Geochronology of events leading to Au-U mineralization at Rompas, Paräpohja Schist Belt, northern Finland: *Goldschmidt Abstracts 2015*, 2170.

Stein, H.J., Yang, G., Grice, K., Georgiev, S.V., and Hannah, J.L. (2015) Re-Os and the Permo-Triassic extinction, Hovea-3, Perth Basin, Western Australia: *Goldschmidt Abstracts 2015*, 2983.

Mikulski, S.Z. and Stein, H.J. (2015) Re-Os age of late bornite-chalcopyrite vein ores, Kupferschiefer, SW Poland (Keynote): *Goldschmidt Abstracts 2015*, 2129.

Yang, G., Zimmerman, A., Stein, H., and Hannah, J. (2015) A highly efficient method to reduce nitric acid Os content to femtogram levels by hydrogen peroxide: *Goldschmidt Abstracts 2015*, 3501.

Georgiev, S.V., Stein, H.J., Hannah, J.L., Yang, G., Dons, C.E., and Pedersen, J.H. (2015) Re-Os ages for a confined petroleum system, Norwegian North Sea: *Goldschmidt Abstracts 2015*, 1024.

Markey, R.J., Stein, H.J., Hannah, J.L., Georgiev, S.V., Pedersen, J.H., Dons, C.E. (2015) Re-Os shale data reveal gravity gliding deformation and surface water circulation, Hekkingen Formation, Loppa High, Barents Sea: *Goldschmidt Abstracts 2015*, 2011.

Stein, H.J., Hannah, J.L., and Yang, G. (2015) Re-Os dating of maturation in unconventional hydrocarbon systems – the critical source-to-sink intermediary: AAPG 3P Arctic, The Polar Petroleum Potential Conference & Exhibition, Stavanger, Sept 29-Oct 2, p. 13-14.

Stein, H.J. and Hannah, J.L. (2015) Ores and climate change – primary shareholders: *Geophysical Research Abstracts*, v. 17, EGU2015-13036.

Stein, H.J., Grice, K., and Hannah, J.L. (2015) Oily ores and ore-encumbered oil: *NGF Abstracts and Proceedings*, no. 1, Vinterkonferansen, Stavanger, p. 93.

Hannah, J.L., Stein, H.J., Marolf, N.J., and Bingen, B. (2015) Ediacaran glaciation in Norway – Climatic revelations from (old) mud: *NGF Abstracts and Proceedings*, no. 1, Vinterkonferansen, Stavanger, p. 38.

Stein, H.J. and Hannah, J.L. (2014) Tiny molybdenites tell diffusion tales: *American Geophysical Union*, December 15-19, San Francisco. Abstract V33A-4837.

Hannah, J.L., Stein, H.J., Marolf, N., and Bingen, B. (2014) Climatic instability and regional glacial advances in the late Ediacaran: *American Geophysical Union*, December 15-19, San Francisco. Abstract PP43C-1493.

Geboy, N., Tripathy, G.R., Ruppert, L.F., Eble, C.F., Blake, M., Hannah, J.L., and Stein, H.J. (2014) Palynology, geochemistry and Re-Os age of the Lower-Middle Pennsylvanian stage boundary, central Appalachian basin, USA: *American Geophysical Union*, December 15-19, San Francisco. Abstract V43D-4929.

Horner, T.J., Georgiev, S.V., Stein, H.J., Hannah, J.L., Bingen, B., and Rehkämper, M. (2014) Cadmium isotopic evidence for increasing primary productivity during the late Permian anoxia: *Geological Society of America Abstracts with Programs*, v. 46, no. 6, p. 581.

Hawke, M., Meffre, S., Stein, H., and Gemmell, B. (2014) Age constraints of the DeGrussa Cu-Au-Ag volcanic-hosted massive sulfide deposit and associated mineralization of the Yerrida, Bryah, and Padbury basins, western Australia: *Australian Earth Sciences Convention (AESC)*, Newcastle, New South Wales, v. 11, p. 259-260.

Barley, M.E. and Stein, H.J. (2014) The Spinifex Ridge 3.3 Ga porphyry Mo-Cu deposit is the world's oldest in one of the first cratons: Goldschmidt Conference, June 8-13, 2014, Sacramento, CA. http://goldschmidt.info/2014/uploads/abstracts/finalPDFs/A-Z.pdf, p. 127.

Georgiev, S.V., Horner, T.J., Stein, H.J., Hannah, J.L., Rehkämper, M. (2014) Cd isotope stratigraphy of Upper Permian shales: Goldschmidt Conference, June 8-13, 2014, Sacramento, CA. http://goldschmidt.info/2014/uploads/abstracts/finalPDFs/A-Z.pdf, p. 789

Georgiev, S.V., Stein, H.J., Hannah, J.L., Galimberti, R.F., Nali, M., and Viscentin, C. (2014) Re-Os geochronology of oil and oil fractions – new advances: Goldschmidt Conference, June 8-13, 2014, Sacramento, CA. http://goldschmidt.info/2014/uploads/abstracts/finalPDFs/A-Z.pdf, p. 790.

Hannah, J.L., Stein, H.J., Xu, G., Georgiev, S.V., Frixa, A., Nali, M., and Galimberti, R.F. (2014) From source to reservoir: Re-Os systematics for hydrocarbon maturation-migration, Iblean Plateau, Sicily: Goldschmidt Conference, June 8-13, 2014, Sacramento, CA. http://goldschmidt.info/2014/uploads/abstracts/finalPDFs/A-Z.pdf, p. 910.

Stein, H.J., Zimmerman, A., Hannah, J.L., and Markey, R.J. (2014) ^{187}Re-^{187}Os geochronometry in molybdenite: 20 years fast forward: Goldschmidt Conference, June 8-13, 2014, Sacramento, CA. http://goldschmidt.info/2014/uploads/abstracts/finalPDFs/A-Z.pdf, p. 2377.

Tripathy, G.R., Hannah, J.L., Stein, H.J., Geboy, N.J., Ruppert, L.F., and Blake, B.M. (2014) Re-Os age for marine-influenced coal: Goldschmidt Conference, June 8-13, 2014, Sacramento, CA. http://goldschmidt.info/2014/uploads/abstracts/finalPDFs/A-Z.pdf, p. 2519.

Stein, H.J., Hannah, J.L., Pandit, M.K., Mohanty, S., Corfu, F., and Zimmerman, A. (2014) Molybdenite tricks with titanite give history of the Central Indian Tectonic Zone: *Geophysical Research Abstracts*, v. 16 (#13209).

Stein, H.J. and Hannah, J.L. (2014) Re-Os and the utility of sulfides in hydrocarbon systems: abstract #1842198, AAPG meeting, Houston, April 6-9, 2014.

Hannah, J.L. and Stein, H.J. (2014) What happens when plate motions change? Re-thinking hydrocarbon expulsion and migration: abstract #1842243, AAPG meeting, Houston, April 6-9, 2014.

Stein, H.J., Hannah, J.L., Yang, G., Nali, M., and Galimberti, R. (2014) Ordovician source rocks and Devonian oil expulsion on bolide impact at Siljan, Sweden – the Re-Os story: Short Version, IPTC meeting, 20-22 January 2014, Doha, Qatar.

Hannah, J.L., Xu, G., Stein, H.J., Galimberti, R., and Nali, M. (2014) Age and composition of source rocks: new steps toward tracking hydrocarbon origin: Short Version, IPTC meeting, 20-22 January 2014, Doha, Qatar.

Stein, H.J. and Hannah, J.L. (2014) The emerging potential of Re-Os isotope geochemistry for source rocks and maturation-migration histories: Short Version, IPTC meeting, 20-22 January 2014, Doha, Qatar.

Georgiev, S., Stein, H.J., and Hannah, J. (2013) Magmatism-induced expansion of sulfidic waters in the Panthalassa Permian-Triassic ocean: *Geological Society of America Abstracts with Programs*, v. 45, no. 7, p. 884.

Stein, H.J. (2013) The contribution of Re-Os isotope geochemistry to de-convoluting ore genesis: invited, *Geological Society of America Abstracts with Programs*, v. 45, no. 7, p. 425.

Tripathy, G.R., Hannah, J.L., Stein, H.J., and Yang, G. (2013) Geographic control of Cambrian-Ordovician ocean chemistry: constraints from shale geochronology and geochemistry: *Geological Society of America Abstracts with Programs*, v. 45, no. 7, p. 199.

Hannah, J.L., Xu, G., and Stein, H.J. (2013) Advancing chronostratigraphy and stratigraphic correlations through Re-Os geochemistry: *Geological Society of America Abstracts with Programs*, v. 45, no. 7, p. 746.

Georgiev, S.V., Xu, G., Stein, H.J., Hannah, J.L., and Weiss, H.M. (2013) Date them all: Re-Os ages for Upper Jurassic-Lower Cretaceous shales, ammonite zones and chrons: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 1156.

Stein, H.J., Hannah, J.L., Yang, G., Løseth, H., Wensaas, L., Cobbold, P. (2013) Eocene hydrocarbon migration, Green River Formation, Utah: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 2258.

Bidzhova, L., Nedialkov, R., Ovtcharova, M., and von Quadt, A. (2013) Precise U-Pb zircon CA-ID-TIMS ages and Sr isotopes for the Plana pluton, Srednogorie, Bulgaria: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 1156.

Xu, G., Hannah, J.L., Stein, H.J., Galimberti, R., and Nali, M. (2013) Rapid recovery of seawater $^{187}Os/^{188}Os$ after CAMP magmatism at the Triassic-Jurassic boundary: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 2525.

Zimmerman, A., Stein, H., and Hannah, J. (2013) Additional insight into natural $^{185}Re/^{187}Re$ of various materials: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 2619.

Yang, G., Stein, H., and Zimmerman, A. (2013) Re-Os analyses for Ag ores from the Kongsberg mines, southeast Norway: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 2546.

Tripathy, G.R., Hannah, J.L., Stein, H.J., and Yang, G. (2013) Geochemistry and Re-Os age for black shales from the Cambrian-Ordovician boundary, Green Point, western Newfoundland: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 2356.

Horner, T.J., Homoky, W.B., Georgiev, S.V., Stein, H.J., Hannah, J.L., Mills, R.A., Rehkämper, M., and Henderson, G.M. (2013) Suboxic sediments as an oceanic sink of isotopically-light cadmium: Goldschmidt Conference, Florence, *Mineralogical Magazine*, v. 77, p. 1323.

Georgiev, S., Stein, H., and Hannah, J. (2013) Correlative isotopic and metal inventories across the Permo-Triassic extinction horizon in Greenland and western Canada: The Permian Strata of Svalbard – *The Permian Strata of Svalbard, Abstracts and Proceedings*, Tromsø, Norway, April 10-12, 2013, p. 13-14.

Stein, H.J., Pandit, M.K., Hannah, J.L., and Torsvik, T.H. (2013) Recurrent metalliferous fluid flow, Khetri Copper Belt, northern Rajasthan, NW India: *Geophysical Research Abstracts* (submitted to EGU General Assembly, Vienna), v. 15 (#11853).

Stein, H., Andrews, S., Hannah, J., Gaina, C., Whitham, A., Yang, G., and Xu, G. (2013) Somebody else's oil is in my beds – Triassic mudstones (Gråklint Beds), Jameson Land, East Greenland: *NGF (Geological Society of Norway) Abstracts and Proceedings*, no. 1, p. 120-121.

Hannah, J.L. and Stein, H.J. (2013) Role of Re-Os isotope geochemistry in building the next generation time scale: *NGF (Geological Society of Norway) Abstracts and Proceedings*, no. 1, p. 50-51.

Hannah, J.L. and Stein, H.J. (2012) Re-Os geochemistry for petroleum geology: *34th International Geological Congress*, August 5-10, 2012, Brisbane, Australia (#3130).

Stein, H.J. and Hannah, J.L. (2012) Working with the source rock record: *34th International Geological Congress*, August 5-10, 2012, Brisbane, Australia (#3103).

Georgiev, S., Stein, H.J., Hannah, J.L., Bingen, B., Weiss, H.M. (2012) Re-Os shale ages constrain onset and duration of Late Jurassic anoxia, Barents Shelf: *Mineralogical Magazine*, 22nd V.M. Goldschmidt Conference, v. 76, no. 6, p. 1750.

Stein, H.J. and Hannah, J.L. (2012) What is source rock?: *Mineralogical Magazine*, 22nd V.M. Goldschmidt Conference, v. 76, no. 6, p. 2406.

Hannah, J.L. Georgiev, S., Xu, G., and Stein, H.J. (2012) A global Os isotope signal in a narrow seaway – the Late Jurassic from the Barents Sea to S. England: *Mineralogical Magazine*, 22nd V.M. Goldschmidt Conference, v. 76, no. 6, p. 1807.

Xu, G., Hannah, J.L., Bingen, B., and Stein, H.J. (2012) Pairing Re-Os systematics with geochemical proxies – environmental conditions and seawater chemistry: *Mineralogical Magazine*, 22nd V.M. Goldschmidt Conference, v. 76, no. 6, p. 2560.

Mikulski, S. and Stein, H.J. (2012) Re-Os age of late bornite-chalcopyrite vein ores, Kupferschiefer, SW Poland: *Mineralogical Magazine*, 22nd V.M. Goldschmidt Conference, v. 76, no. 6, p. omitted.

Stein, H.J., Andrews, S.D., Hannah, J.L., Gaina, C., Whitham, A.G., Yang, G., and Xu, G. (2012) Triassic mudstones (Gråklint Beds) containing hydrocarbons with early Barremian and Santonian ages, Jameson Land, East Greenland: abstract #1236837, AAPG meeting, Long Beach, CA, April 22-25, 2012.

Hannah, J.L. and Stein, H.J. (2012) Time lines, time scales, and correlations – getting it right: abstract #1236685, AAPG meeting, Long Beach, CA, April 22-25, 2012.

Stein, H.J., Hannah, J.L., Bingen, B., Georgiev, S., and Xu, G. (2011) Real time correlations and conditions during source rock deposition using Re-Os geochemistry: abstract booklet, invited presentation, FORCE meeting, October 11-12, 2011, Stavanger.

Stein, H.J. and Hannah, J.L. (2011) Re-Os geochemistry for Arctic chronology – time will tell: AAPG Search and Discovery Article #90130©2011 3P Arctic, The Polar Petroleum Potential Conference & Exhibition, Halifax, Nova Scotia, Canada 30 August-2 September, 2011.

Hannah, J.L. and Stein, H.J. (2011) Re-Os time lines crack stratigraphic puzzles in the Barents and adjacent basins: AAPG Search and Discovery Article #90130©2011 3P Arctic, The Polar Petroleum Potential Conference & Exhibition, Halifax, Nova Scotia, Canada 30 August-2 September, 2011.

Georgiev, S., Stein, H., Hannah, J., Bingen, B., Hatløy, V., Rein, E., Piasecki, S., Weiss, H., Xu, G. (2011) Weathering of black shales and Re-Os isotope systematics: Goldschmidt Conference Abstract, *Mineralogical Magazine*, v. 75, no. 3, p. 907.

Hannah, J., Stein, H., Yang, G., and Maletz, J. (2011) Pairing Re-Os geochronology and biostratigraphy – dating fossils: Goldschmidt Conference Abstract, *Mineralogical Magazine*, v. 75, no. 3, p. 976.

Mikulski, S.Z., Gawęda, A., and Stein, H.J. (2011) Re-Os age of molybdenite from the Tatra Mountains, Poland: Goldschmidt Conference Abstract, *Mineralogical Magazine*, v. 75, no. 3, p. 1470.

Stein, H.J. (2011) Fluids on the loose – capturing meaningful geochronology in sulphides: Goldschmidt Conference Abstract (invited keynote), *Mineralogical Magazine*, v. 75, no. 3, p. 1934.

Xu, G., Hannah, J.L., Stein, H.J., Mørk, A., Bingen, B., and Lundschien, B.A. (2011) Re-Os geochronology of black shale from the Barents Sea: refining the Triassic time scale: Goldschmidt Conference Abstract, *Mineralogical Magazine*, v. 75, no. 3, p. 2196.

Zimmerman, A., Georgiev, S., Yang, G., Stein, H., and Hannah, J. (2011) Possible rhenium fractionation during standard Re-Os dissolution and chemical separation procedures: Goldschmidt Conference Abstract, *Mineralogical Magazine*, v. 75, no. 3, p. 2287.

Kohút, M., Stein, H.J., and Uher, P. (2011) The Rochovce granite – a witness of Cretaceous tectonism in the Western Carpathians (Slovakia): VII Hutton Symposium on Granites and Related Rocks, Avila, Spain, 4-9 July 2011, p. 78.

Stein, H., Georgiev, S., Bingen, B., and Hannah, J. (2011) Magmatic-hydrothermal systems that fail to make the grade – where have all the metals gone?: *NGF Abstracts and Proceedings of the Geological Society of Norway*, Vinterkonferansen, Stavanger, January 11-13, 2011, p. 94-95.

Georgiev, S., Stein, H., Hannah, J., Bingen, B., Piasecki, S., and Weiss, H. (2011) Killer seawater – Re-Os geochemistry matches up oxygen-starved Mid-Norwegian shelf and East Greenland basins: *NGF Abstracts and Proceedings of the Geological Society of Norway*, Vinterkonferansen, Stavanger, January 11-13, 2011, p. 31.

Hannah, J.L., Stein, H.J., Bingen, B., Xu, G., and Georgiev, S. (2011) Re-Os geochemistry of black shales: consolidating litho-, bio-, chemo-, and chronostratigraphy: *NGF Abstracts and Proceedings of the Geological Society of Norway*, Vinterkonferansen, Stavanger, January 11-13, 2011, p. 36-37.

Slagstad, T., Roberts, N.M.W., Marker, M., Røhr, T.S., Schiellerup, H., Stein, H.J. (2011) A non-collisional tectonic interpretation for the Late Mesoproterozoic Sveconorwegian orogeny: *NGF Abstracts and Proceedings of the Geological Society of Norway*, Vinterkonferansen, Stavanger, January 11-13, 2011, p. 91-92.

Stein, H.J. and Hannah, J.L. (2010) Sulfur isotope signals in molybdenite – messages from the past: Abstract V34C-08 presented at 2010 Fall Meeting, AGU, San Francisco, 13-17 December.

Hannah, J.L., Stein, H., Yang, G., and Zimmerman, A. (2010) Paleoproterozoic pyrobitumen: Re-Os geochemistry reveals the fate of giant carbon accumulations in Russian Karelia: Abstract U33A-0012 presented at 2010 Fall Meeting, AGU, San Francisco, 13-17 December.

Georgiev, S., Stein, H., Hannah, J.L., Bingen, B., Xu, G., Piasecki, S., and Weiss, H.M. (2010) Re-Os systematics of Arctic black shales reveal extraordinary conditions approaching the Permo-Triassic boundary: *Geological Society of America Abstracts with Programs*, v. 42, no. 5, p. 70.

Xu, G., Hannah, J.L., Bingen, B., Stein, H.J., and Georgiev, S. (2010) Digestion methods for trace element measurements in shales: Paleoredox proxies examined: *Geological Society of America Abstracts with Programs,* v. 42, no. 5, p. 561.

McMillan, M.M., Downs, R.T., Stein, H.J., Zimmerman, A., Beitscher, B., Sverjensky, D.A., Papineau, D., Armstrong, J., Hazen, R.M. (2010) Molybdenite mineral evolution: a study of trace elements through time: *Geological Society of America Abstracts with Programs,* v. 42, no. 5, p. 93.

Wieser, B., Raith, J.G., Thöni, M., Cornell, D., Stein, H., and Paar, W.H. (2010) In-situ trace element and ID-TIMS Sm-Nd analysis of scheelite and Re-Os dating of molybdenite at Schellgaden, a Au-(W) deposit in the Eastern Alps, Austria: *Proceedings Pangeo Austria 2010*, Leoben, Austria, 15-19 September 2010, *Journal of Alpine Geology*, v. 52, p. 253-254.

Raith, J.G., Wieser, B., Thöni, M., Cornell, D., Stein, H., and Paar, W.H. (2010) In-situ trace element and ID-TIMS Sm-Nd analysis of scheelite and Re-Os dating of molybdenite at Schellgaden, a Au-(W) deposit in the Eastern Alps, Austria: *IMA 2010 Budapest Bonds and Bridges*, The 20th General

Meeting of the International Mineralogical Association, 21-27 August 2010, Budapest, Hungary, Acta Mineralogica-Petrographica, Abstract Series, p. 259.

Georgiev, S., Stein, H., Hannah, J., Bingen, B., Xu, G., and Piasecki, S. (2010) Precise Re-Os age with exceptionally high $^{187}Re/^{188}Os$ for black shales heralds Permo-Triassic extinction, Norwegian shelf and East Greenland: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A324.

Stein, H., Bingen, B., Georgiev, S., Hannah, J., and Zimmerman, A. (2010) The Permo-Triassic crisis – a new cause for a well-documented effect: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A992.

Zimmerman, A., and Stein, H.J. (2010) Common Os in molybdenite: how negligible is negligible?: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A1237.

Xu, G., Hannah, J., Stein, H., Zimmerman, A., Yang, G., Georgeiv, S., and Bingen, B. (2010) Sampling challenges in Re-Os geochronology of black shale: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A1158.

Bingen, B., Xu, G., Hannah, J.L., Stein, H.J., and Georgiev, S. (2010) Sample digestion methods for trace element measurement: paleoredox proxies under scrutiny: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A92.

Hannah, J., Yang, G., Stein, H., and Zimmerman, A. (2010) Birth of a giant Paleoproterozoic oil field: Re-Os ages for source rocks and maturation: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A379.

Yang, G., Stein, H., Hannah, J., and Zimmerman, A. (2010) Targeted drilling for Re-Os geochronology to decipher complex history of overmature source rocks and migrated hydrocarbons: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A1172.

Mikulski, S.Z. and Stein, H.J. (2010) Re-Os age of a chalcopyrite sample from the Lubin Cu-Ag mine, Kupferschiefer, SW Poland: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A708.

Wiszniewska, J., Krzemínska, E., Krzemínski, L., Demaiffe, D., Stein, H., Williams, I.S. (2010) A new early Carboniferous alkaline province in the crystalline basement of NE Poland: *Geochimica et Cosmochimica Acta*, v. 74, no. 12, Supplement 1, p. A1139.

Rapprecht, R., Stewart, K., LaPoint, D., and Stein, H. (2010) A study of Late-Proterozoic host rocks, their style of alteration and age of mineralization at the Deep River Gold prospect, Randolph and Moore counties, North Carolina: Abstract #2423, Poster A-44, SEG 2010 Conference, *The Challenge of Finding New Mineral Resources: Global Metallogeny, Innovative Exploration and New Discoveries*, Keystone Colorado, October 2-5, 2010, p. 18.

Barley, M.E. and Stein, H.J. (2010) The Spinifex Ridge 3.3 Ga porphyry-style Mo-Cu deposit, East Pilbara, Western Australia, the world's oldest: *Australian Earth Sciences Convention, Canberra (AESC)*, v. 98, p. 76-77.

Stein, H.J., Hannah, J.L., Bingen, B., Georgiev, S., and Xu, G. (2010) Changing conditions across the Permo-Triassic boundary: evidence from the Re-Os isotopic system: *AAPG 2010 Annual Convention and Exhibition*, New Orleans, abstract #736804 (CD), v. 19, p. 244-245.

Hannah, J.L., Stein, H.J., Bingen, B., Xu, G., and Georgiev, S. (2010) Application of Re-Os isotope systematics to basin modeling in the Norwegian Arctic: *AAPG 2010 Annual Convention and Exhibition*, New Orleans, abstract #729164 (CD), v. 19, p. 99.

Xu, G., Hannah, J.L., Bingen, B., Stein, H.J., and Georgiev, S. (2010) Re-Os isotopic tracing of hydrocarbon systems in Arctic regions: case study of Middle Triassic black shales from Svalbard and Svalis Dome, *in* Nakrem, H.A., Harstad, A.O., and Haukdal, G. (eds), *Abstracts and Proceedings of the Geological Society of Norway*, Nordic Geological Winter Meeting, 10-13 January, Oslo, p. 213.

Georgiev, S., Stein, H.J., Bingen, B., Hannah, J.L., and Xu, G. (2010) Re-Os age and low initial $^{187}Os/^{188}Os$ for Upper Permian black shales from the mid-Norwegian shelf record the Permian-Triassic transition crisis: *in* Nakrem, H.A., Harstad, A.O., and Haukdal, G. (eds), *Abstracts and Proceedings of the Geological Society of Norway*, Nordic Geological Winter Meeting, 10-13 January, Oslo, p. 58-59.

Georgiev, S., Stein, H.J., Hannah, J.L., Bingen, B., Xu, G., Yang, G., Zimmerman, A., and Weiss, H.M. (2009) Precise Re-Os age and low initial $^{187}Os/^{188}Os$ for latest Permian black shales from the mid-Norwegian shelf herald the Permo-Triassic extinction: *EOS, Transactions*, AGU fall meeting, CD-ROM GP23B-0795.

Shaver, S. A., Manske, S.L., Currie, J., Fahey, P.L., Maya, J., Stein, H.J., and Huard, J.J. (2009) The Sierra Gorda porphyry Cu-Mo(Au) deposit, region II, northern Chile, part 2: intrusive relations and $^{40}Ar/^{39}Ar$ and Re-Os molybdenite geochronology of the Catalina and 281-zone mineralization centers: *Geological Society of America Abstract with Programs*, v. 41, no. 7, p. 84.

Khin Zaw, Meffre, S., Kamvong, T., Khositanont, S., Stein, H., Vasconcelos, P., and Golding, S. (2009) Geochronology and metallogenic setting of Cu-Au skarn deposits, Loei Fold Belt, Thailand and Lao PDR: 6th Annual Meeting AOGS (Asia Oceania Geosciences Society), 11-15 August 2009, Singapore, CD-ROM.

Qu, W.J., Du, A., Yang, G., Li, C., Stein, H.J., Hannah, J.L. (2009) Highly precise isotopic ratio of osmium determination for copper-nickel-sulfide sample from Jinchuan, China: submitted for Geoanalysis meeting, Sept 7-11, 2009, Champagne Sport Resort, South Africa.

Stein, H.J., Yang, G., Zimmerman, A., Hannah, J.L., Egenhoff, S. (2009) Re-Os fractionation on instantaneous maturation at the Siljan impact site, central Sweden: *AAPG Annual Convention and Exhibition Abstracts Volume*, v. 18, p. 203.

Xu, G., Hannah, J.L., Stein, H.J., Bingen, B., Yang, G., Zimmerman, A., Weitschat, W., and Weiss, H.M. (2009) Application of Re-Os chronology to hydrocarbon exploration: case study of Middle Triassic black shales from the Barents Sea and Svalbard: *AAPG Annual Convention and Exhibition Abstracts Volume*, v. 18, p. 232.

Stein, H., Yang, G., Hannah, J.L., Zimmerman, A., and Egenhoff, S. (2009) Re-Os fractionation on instantaneous maturation at the Siljan meteorite impact site, central Sweden: *Geochimica et Cosmochimica Acta*, v. 73, no. 13, p. A1268.

Xu, G., Hannah, J.L., Stein, H.J., Bingen, B., Yang, G., Zimmerman, A., Weitschat, W., and Weiss, H. (2009) Re-Os geochemistry of Barents Sea shales: Anisian-Ladinian stage boundary, faunal

distributions, and hydrocarbon exploration: *Geochimica et Cosmochimica Acta*, v. 73, no. 13, p. A1463.

Yang, G., Stein, H.J., Hannah, J.L., Zimmerman, A., and Bjørlykke, A. (2009) Re-Os systematics of sulfides in overmature and altered shale, Bidjovagge Cu-Au deposit, northern Norway (Finnmark): *Geochimica et Cosmochimica Acta*, v. 73, no. 13, p. A1473.

Zimmerman, A., Yang, G., Stein, H.J., Hannah, J.L., and Egenhoff, S. (2009) Out of this world crude oil – separating meteoritic and hydrocarbon Re-Os components: *Geochimica et Cosmochimica Acta*, v. 73, no. 13, p. A1536.

Hannah, J.L., Yang, G., Xu, G., Zimmerman, A., Stein, H.J., Bingen, B., and Egenhoff, S. (2009) Re-Os isotopic disturbances at unconformities: challenges and opportunities: *Geochimica et Cosmochimica Acta*, v. 73, no. 13, p. A491.

Du, A., Qu, W., Stein, H., Yang, G., Hannah, J., Yang, S. and Li, C. (2009) Certification of Os concentration and $^{187}Os/^{188}Os$ for Co-rich crust MCPt-1 reference material: Central Pacific Seamount Zone: *Geochimica et Cosmochimica Acta*, v. 73, no. 13, p. A306.

Stein, H., Zimmerman, A., Yang, G., Hannah, J., and Egenhoff, S. (2009) Hydrocarbon maturation and Os mixing on bolide impact at the Frasnian-Famennian boundary: *Geophysical Research Abstracts*, v. 11, European Geosciences Union (EGU), EGU2009-11085-1 (electronic).

Beitscher, B., Stein, H.J., Hannah, J.L., and Zimmerman, A. (2008) Trace elements in molybdenite as indicators of tectono-metallogenic settings: *EOS Transactions*, AGU, 89 (53), Fall Meeting Supplement, Abstract V33B-2225.

Yang, G., Stein, H., Hannah, J., Zimmerman, A., Bjørlykke, A., and Bingen, B. (2008) Re-Os systematics of shale-hosted Cu-Au mineralization at the Bidjovagge deposit in northern Norway (Finnmark): *EOS Transactions*, AGU, 89 (53), Fall Meeting Supplement, Abstract T23C-2071.

Hannah, J.L., Yang, G., Xu, G., Zimmerman, A., Stein, H., and Egenhoff, S. (2008) Re-Os Isotopic Disturbances at Unconformities: Challenges and Opportunities: *EOS Transactions*, AGU, 89 (53), Fall Meeting Supplement, Abstract PP31C-1519.

Stein, H., Bingen, B., Yang, G., and Ihlen, P. (2008) Hydrocarbons and Au deposits (and their pyrite) – is there a link?: *EOS Transactions*, AGU, 89 (53), Fall Meeting Supplement, Abstract T23C-2072.

Xu, G., Hannah, J.L., Bingen, B., Stein, H.J., Yang, G., Zimmerman, A, Weitschat, W., Weiss, H.M. (2008) Re-Os Geochronology Pins Age and Os Isotope Composition of Middle Triassic Black Shales and Seawater, Barents Sea and Spitsbergen: *EOS Transactions*, AGU, 89 (53), Fall Meeting Supplement, Abstract PP33B-1534.

Stein, H.J., Bingen, B., Yang, G., and Ihlen, P. (2008) Re-Os dating of pyrite generations and late hydrocarbons associated with gold deposits – post-Sveconorwegian construction of Norway's Eidsvoll Au deposit: *33rd International Geological Congress (IGC)*, 6-14 August 2008, Oslo, electronic abstract 1353034.

Hannah, J.L., Stein, H.J., Zimmerman, A., Yang, G., Melezhik, V.A., Filippov, M.M., Turgeon, S.C., and Creaser, R.A. (2008) Re-Os geochronology of a 2.05 Ga fossil oil field near Shunga, Karelia, NW

Russia: *33rd International Geological Congress (IGC)*, 6-14 August 2008, Oslo, electronic abstract 1352701.

Stein, H.J., Yang, G., Hannah, J.L., Zimmerman, A., Pandit, M.K., Raut, P.K., Gaina, C., and Torsvik, T.H. (2008) India's journey using Re-Os to date reactivation of ancient sutures: *33rd International Geological Congress (IGC)*, 6-14 August 2008, Oslo, electronic abstract 1353626.

Mikulski, S.Z. and Stein, H.J. (2008) Re-Os ages for molybdenites from the Karkonosze massif, Sudetes (SW Poland): *33rd International Geological Congress (IGC)*, 6-14 August 2008, Oslo, electronic abstract 1345464.

Barley, M.E., Stein, H.J., Cummins, B., and Bekker, A. (2008) The Spinifex Ridge 3.3 Ga porphyry-style Mo-Cu deposit, East Pilbara, Western Australia: *33rd International Geological Congress (IGC)*, 6-14 August 2008, Oslo, electronic abstract 1338021.

Bjerkgård, T., Stein, H.J., Bingen, B., Henderson, I.H.C., Sandstad, J.S., and Moniz, A. (2008) The Niassa gold belt, northern Mozambique – part of a continental-scale Pan-African gold-bearing structure: *33rd International Geological Congress (IGC)*, 6-14 August 2008, Oslo, electronic abstract 1341864.

Stein, H.J. (2008) Re-Os dating of Au-related arsenopyrite and India's separation from Pangea: 59th BHT Lagerstätten-Kolloquim, TU Bergakademie, Freiberg, p. A4-A5.

Hannah, J.L., Stein, H.J., Zimmerman, A., Yang, G., Melezhik, V.A., Filippov, M.M. Turgeon, S.C., and Creaser, R.A. (2008) Re-Os geochronology of shungite: a 2.05 Ga fossil oil field in Karelia: *Geochimica et Comochimica Acta*, v. 72, no. 12S, p. A351.

Zimmerman, A., Stein, H., and Watanabe, Y. (2008) The El Salvador Cu deposit, Chile: insight from a decade of Re-Os data: *Geochimica et Comochimica Acta*, v. 72, no. 12S, p. A1106.

Kendall, B., Hannah, J.L., Yang, G., Stein, H.J., Creaser, R.A., Anbar, A.D., and Arnold, G.L. (2008) Crustal versus hydrothermal sources to 2.7-2.3 Ga seawater: constraints from Os isotopes and Re, Mo abundances in black shales: *Geochimica et Comochimica Acta*, v. 72, no. 12S, p. A463.

Hannah, J.L., Stein, H.J., Yang, G., Zimmerman, A., and Bingen, B. (2008) Re-Os dating of black shales: timing and duration of sedimentary processes: *AAPG 2008 Annual Convention and Exhibition Abstracts*, v. 17, p. 75.

Stein, H.J. and Hannah, J.L. (2008) Re-Os geochemistry of source rocks and hydrocarbons: ages, correlations, and timing of migration: *AAPG 2008 Annual Convention and Exhibition Abstracts*, v. 17, p. 196. [Received AAPG ten best poster award, Annual Convention and Exhibition]

Stein, H.J., Yang, G., Hannah, J.L., Zimmerman, A., Pandit, M.K., Raut, P.K., Gaina, C., and Torsvik, T. H. (2008) Plumes with gold and no LIPs: Knowing where the hot spots are: *Geophysical Research Abstracts*, v. 10, EGU2008-A-00000, EGU General Assembly 2008, Vienna, Austria.

Larsen, R.B. and Stein, H.J. (2007) Re-Os dating of orogenic W-Mo deposits in the mid-Norwegian Caledonides: *Geological Society of America Abstracts with Programs*, v. 39, no. 6, p. 276.

Markey, R.J., Zimmerman, A., Stein, H.J., Hannah, J.L., Selby, D., and Creaser, R.A. (2007) A new molybdenite reference material (RM) from Henderson, Colorado for interlaboratory comparison

and global standardization: *Geological Society of America Abstracts with Programs*, v. 39, no. 6, p. 276.

Yang, G., Hannah, J.L., Zimmerman, A., Stein, H.J., and Bekker, A. (2007) Re-Os dating of C-rich slate from the western Wawa subprovince, Minnesota: *Geological Society of America Abstracts with Programs*, v. 39, no. 6, p. 274.

Hannah, J.L., Stein, H.J., Wieser, M.E., deLaeter, J.R., Varner, M.D. (2007) Vapor transport and Raleigh fractionation of Mo isotopes during magmatic/hydrothermal processes: implications for ore genesis: *Geological Society of America Abstracts with Programs*, v. 39, no. 6, p. 275.

Stein, H.J., Yang, G., Zimmerman, A., Pandit, M.K., Raut, P.K., and Hannah, J.L. (2007) Re-Os dating of arsenopyrite: panacea or problematic?: *Geological Society of America Abstracts with Programs*, v. 39, no. 6, p. 276.

Perelló, J., Sillitoe, R.H., Brockway, H., Posso, H., East, P., Solé, M., Stein, H. (2007) Los Pelambres, Chile: recent advances in the geologic understanding of a major Cu-Mo and Cu-Au porphyry system: *Proceedings of Ores and Orogenesis Conference*, Tucson, Arizona, p. 133-134.

Salam, A., Khin Zaw, Meffre, S., James, R., and Stein, H. (2007) Geological setting, alteration, mineralisation and geochronology of Chatree epithermal gold-silver deposit, Phetchabun province, central Thailand: *Proceedings of Ores and Orogenesis Symposium*, Tucson, Arizona, p. 181.

Hannah, J.L., Yang, G., Bingen, B., Stein, H., and Zimmerman, A. (2007) ~560 Ma and ~300 Ma Re-Os ages constrain Neoproterozoic glaciation and record Variscan hydrocarbon migration on extention of the Oslo rift: in Redfield, T., Buiter, S.J.H., Smethurst, M.A. (eds), Geodynamics, Geomagnetism, and Paleogeography: A 50 Year Celebration, *NGU Report* 2007.057, p. 50.

Stein, H. (2007) Meaningful Re-Os geochronology: from rocks to results: 7th International Symposium on Applied Isotope Geochemistry, Stellenbosch, South Africa, *AIG7 Abstract Volume*, p. 137-138.

Hannah, J.L. and Stein, H.J. (2007) Re-Os geochemistry of carbonaceous shales and oils: source and timing of hydrocarbon migration: 7th International Symposium on Applied Isotope Geochemistry, Stellenbosch, South Africa, *AIG7 Abstract Volume*, p. 65-66.

Stein, H.J., Barley, M.E., Zimmerman, A., and Cummins, B. (2007) A 3.3 Ga Mo-Cu porphyry-style deposit at Spinifex Ridge, East Pilbara, Western Australia: Re-Os dating of Paleoarchean molybdenite: *Geochimica et Cosmochimica Acta*, v. 71, no. 15, p. A970.

Yang, G., Hannah, J.L., Zimmerman, A., Stein, H.J., and Bekker, A. (2007) 2.7 Ga Re-Os age for C-rich slate of the Joy Lake sequence, western Wawa subprovince, Minnesota: *Geochimica et Cosmochimica Acta*, v. 71, no. 15, p. A1138.

Hannah, J.L., Yang, G., Bingen, B., Stein, H.J., and Zimmerman, A. (2007) ~560 Ma and ~300 Ma Re-Os ages constrain Neoproterozoic glaciation and record Variscan hydrocarbon migration on extension of Oslo rift: *Geochimica et Cosmochimica Acta*, v. 71, no. 15, p. A378.

Zimmerman, A., Stein, H.J., Hannah, J.L., Tuttas, B., Yang, G., and Beitscher, B. (2007) Instrumental mass fractionation overcome by total evaporation: *Geochimica et Cosmochimica Acta*, v. 71, no. 15, p. A1176.

Salam, A., Khin Zaw, Mefre, S., James, R., Stein, H., and Vasconcelos, P. (2007) Geological setting, mineralisation and geochronology of Chatree epithermal gold-silver deposit, Phetchabun province, central Thailand: *Proceedings of Asia Oceania Geosciences Society (AOGS)*, 4th annual meeting, Bangkok, p. 249, CD-ROM.

Stein, H. (2007) Impact of Re-Os on geoscience: A radiometric clock and tracer for magmatism, metamorphism, tectonics, ores, and hydrocarbons: invited lecture, U.S. Geological Survey, 22 May 2007, with circulated abstract.

Hannah, J.L. and Stein, H.J. (2007) Re-Os geochemistry of carbonaceous shales and oils: source and timing of hydrocarbon migration: invited lecture, U.S. Geological Survey, 22 May 2007, with circulated abstract.

Stein, H.J. and Markey, R.J. (2007) Dating episodic volatile release in magmas: the entrapped hydrothermal record: *NGF Abstracts and Proceedings of the Geological Society of Norway* (Vinterkonferansen), no. 1, p. 95-96.

Stein, H.J. and Bingen, B. (2007) The roots of a 1760 Ma porphyry Cu-Mo belt in SE Norway and its Paleoproterozoic metamorphism and deformation at ~1735 and ~1710 Ma: *NGF Abstracts and Proceedings of the Geological Society of Norway* (Vinterkonferansen), no. 1, p. 94-95.

Hannah, J.L., Stein, H.J., Zimmerman, A., Yang, G., Markey, R.J., and Melezhik, V.A. (2007) Precise Re-Os depositional age for the Paleoproterozoic Pilgujärvi sedimentary formation, Pechenga greenstone belt, Kola Peninsula, Russia: *NGF Abstracts and Proceedings of the Geological Society of Norway* (Vinterkonferansen), no. 1, p. 36-37.

Hannah, J.L., Stein, H.J., Zimmerman, A., and Yang, G. (2007) Re-Os geochemistry of source rocks and hydrocarbons: ages, correlations, and timing of migration: *NGF Abstracts and Proceedings of the Geological Society of Norway* (Vinterkonferansen), no. 1, p. 37-38.

Stein, H.J. (2006) What are we dating with our highly precise ages?: invited paper, *Geoanalysis meeting*, 19-21 September 2006, Beijing China.

Hannah, J.L., Stein, H.J., Zimmerman, A., Yang, G., Markey, R.J., and Melezhik, V.A. (2006) Precise depositional Re-Os age for black shale: a Paleoproterozoic example: invited paper, *Geoanalysis meeting*, 19-21 September 2006, Beijing China.

Stein, H.J., Markey, R.J., Carriedo, J., and Tornos, F. (2006) Re-Os evidence for the origin of Fe-oxide-(Cu-Au) deposits in SW Iberia at the Frasnian-Famennian boundary: *Geochimica et Cosmochimica Acta*, v. 70, no. 18S, p. A612. doi:10.1016/j.gca.2006.06.1135

Stein, H.J. and Markey, R.J. (2006) Timescales for fluid storage and release in porphyry Cu-Mo systems – Timescales for felsic magma storage and volcanic eruptions: *Geochimica et Cosmochimica Acta*, v. 70, no. 18S, p. A613. doi:10.1016/j.gca.2006.06.1136

Zimmerman, A., Stein, H., Hannah, H., Kozelj, D., and Berza, T. (2006) Re-Os and tectonics – chronology, concentrations, and commodities in the South Carpathians and Balkans: *Geochimica et Cosmochimica Acta*, v. 70, no. 18S, p. A755. doi:10.1016/j.gca.2006.06.1362

Hannah, J.L., Stein, H.J., Wieser, M.E., deLaeter, J.R., and Varner, M.D. (2006) Mo isotope variations in molybdenite: vapour transport and Rayleigh fractionation of Mo: *Geochimica et Cosmochimica Acta*, v. 70, no. 18S, p. A228. doi:10.1016/j.gca.2006.06.460

Hannah, J.L., Stein, H.J., Zimmerman, A., Yang, G., Markey, R.J., and Melezhik, V.A. (2006) Precise 2004 ± 9 Ma Re-Os age for Pechenga black shale: Comparison of sulfides and organic material: *Geochimica et Cosmochimica Acta*, v. 70, no. 18S, p. A228. doi:10.1016/j.gca.2006.06.461

Bingen, B., Stein, H., Corfu, F., Hannah, J. (2006) Paired Re-Os molybdenite and U-Pb zircon ages resolve Mo ore-forming events in magmatic-metamorphic environment, Knaben district, S Norway: *Geophysical Research Abstracts*, v. 8, 04013 (electronic) EGU meeting, April 2-7, Vienna.

Zimmerman, A., Stein, H., and Hannah, J. (2005) Tethyan metallogenesis: Re-Os geochronology of the Panagyurishte district, Bulgaria: *Geological Society of America Abstracts with Programs*, v. 37, no. 7, p. 97.

Kelson, C.R., Crowe, D.E., and Stein, H.J. (2005) Geochronology and geochemistry of the Hilltop, Lewis, and Bullion mining districts, Battle Mountain-Eureka trend, Nevada: *Geological Society of America Abstracts with Programs*, v. 37, no. 7, p. 314.

De Laeter, J. Wieser, M., Stein, H., and Hannah, J. (2005) Application of molybdenum isotope fractionation measurements in ore deposit studies: *AIG-6 meeting (Applied Isotope Geology)*, September 11-16, 2005, Prague, Czech Republic.

Stein, H.J. (2005) New model for the Butte Cu-Mo porphyry and polymetallic vein deposits, and the hosting Boulder batholith, SW Montana, USA: *Geochimica et Cosmochimica Acta*, v. 69, no. 10S, p. A566.

Bingen, B., Stein, H.J., Corfu, F., Hamilton, M.A., Hannah, J.L., and Henderson, I.A.C. (2005) Molybdenite deposits: time markers for orogenic processes, example from SW Scandinavia: *Geochimica et Cosmochimica Acta*, v. 69, no. 10S, p. A565.

Kelson, C.R., Crowe, D.E., and Stein, H.J. (2005) Geochronology and geochemical study of part of the Battle Mountain – Eureka trend, Nevada: *Geochimica et Cosmochimica Acta*, v. 69, no. 10S, p. A567.

Hannah, J.L., Stein, H.J., and Bekker, A. (2005) Atmospheric evolution and metallogenesis: cycling of redox-sensitive metals: *Geochimica et Cosmochimica Acta*, v. 69, no. 10S, p. A569.

Mikulski, S.Z., Markey, R.J., and Stein, H.J. (2005) The first Re-Os ages of auriferous sulfides from the European Variscides: *Geochimica et Cosmochimica Acta*, v. 69, no. 10S, p. A572.

Dilles, J.H., Stein, H.J., and Martin, M.W. (2004) Re-Os and U-Pb ages for the duration of the giant Butte, Montana, porphyry Cu-Mo and Cordilleran base metal lode ore deposit: (electronic, session 12a) IAVCEI General Assembly, Pucón, Chile.

Martinsson, O., Williams, P.J., Edfelt, Å., Sandrin, A., Verco, M., Evins, P., Mark, G., Billström, K., Stein, H., Broman, C., and Weihed, P. (2004) Relationships of Kiruna-type apatite iron ores and iron oxide-copper-gold deposits, Norrbotten, Sweden: (electronic, session 1a) IAVCEI General Assembly, Pucón, Chile.

Stein, H., Cannell, J., Cooke, D., Sillitoe, R., and Perelló, J. (2004) Metalliferous moments inside the lifespan of porphyry-style Cu-Au-Mo deposits: (electronic, session 12a) IAVCEI General Assembly, Pucón, Chile.

Lundmark, C., Weihed, P., Stein, H., Billström, K. (2004) Vaikijaur, a Palaeoproterozoic Cu-Au-(Mo) porphyry style deposit at the Archaean-Proterozoic paleoboundary in northern Sweden: (electronic, session 1c) IAVCEI General Assembly, Pucón, Chile.

Hannah, J.L., Stein, H.J., Markey, R.M., and Bekker, A. (2004) Chondritic $^{187}Os/^{188}Os$ in Late Archean-Early Paleoproterozoic seawater indicates low riverine flux of Os under anoxic weathering conditions: *Geological Society of America Abstracts with Programs*, v. 36, no. 5, p. 339.

Loeppke, N.A. and Hannah, J.L. (2004) Re-Os systematics in Fe-Ti oxides from Proterozoic anorthosite complexes: *Geological Society of America Abstracts with Programs*, v. 36, no. 5, p. 508.

Stein, H. (2004) Late Archean-Early Paleoproterozoic continental assembly of India and East Antarctica: *Geological Society of America Abstracts with Programs*, v. 36, no. 5, p. 340.

Stein, H.J. (2004) Re-Os geochemistry: the last decade and what lies ahead: SEG Conference, Eugen Stumpfl Memorial Symposium, Perth, WA, p. 327.

Stein, H.J. (2004) Using the Re-Os molybdenite chronometer for dating anatexis in the Paleoproterozoic (Svecofennian orogeny), northern Sweden: *32nd International Geologic Congress*, abstract volume posted on-line, abstract 297-20.

Hannah, J.L., Stein, H.J., Bekker, A., and Holland, H.D. (2004) Re-Os geochemistry of carbonaceous shales: dating changes in atmospheric composition and Os cycling: *32nd International Geologic Congress*, abstract volume posted on-line, abstract 210-9.

Bingen, B., Stein, H., Bogaerts, M., Bolle, O., and Mansfeld, J. (2004) Re-Os dating of molybdenite constrains late-orogenic gneiss dome formation in the Svecofennian orogen, SW Scandinavia: *32nd International Geologic Congress*, abstract volume posted on-line, abstract 297-18.

Mao, J., Stein, H., Wang, Y., and Yu, J. (2004) Molybdenite Re-Os and albite $^{40}Ar/^{39}Ar$ dating of the Cu-Au-Mo-(Fe) deposits and porphyry-associated iron deposits in the Middle-Lower Yangtze River belt and implications for metallogenesis: *32nd International Geologic Congress*, abstract volume posted on-line, abstract 8-49.

Stein, H. and Bingen, B. (2004) Molybdenite by metamorphism: tracking orogenic cycles: *Geochimica et Cosmochimica Acta*, v. 68, no. 115, p. A666.

Markey, R., Stein, H.J., Hannah, J.L., Selby, D., and Creaser, R.A. (2004) Characterization of a molybdenite Reference Material for Re-Os: *Geochimica et Cosmochimica Acta*, v. 68, no. 115, p. A543.

Hannah, J.L., Stein, H.J., Markey, R.J., and Scherstén, A. (2004) Gold: A Re-Os geochronometer?: *Geochimica et Cosmochimica Acta*, v. 68, no. 115, p. A773.

Bekker, A., Holland, H.D., Wang, P.-L., Rumble, D. III, Stein, H.J., Hannah, J.L., Coetzee, L.L., and Beukes, N.J. (2004) Dating the rise of atmospheric oxygen: *Geochimica et Cosmochimica Acta*, v. 68, no. 115, p. A780.

Wieser, M., DeLaeter, J.R., Stein, H., Tuttas, D., and Schwieters, J. (2004) Molybdenum isotope abundance variations measured in molybdenites by double-spiking thermal ionization mass spectrometry: *Geochimica et Cosmochimica Acta*, v. 68, no. 115, p. A376.

Mark, G., Stein, H., and Salt, C. (2004) Re-Os isotopic evidence for two periods of sulfide mineralisation in the vicinity of the Ernest Henry Cu-Au deposit, northwest Queensland, Australia: *17th Australian Geological Convention*, 8-13 February, 2004, Hobart, p. 96.

Dilles, J.H., Martin, M.W., Stein, H.J., and Rusk, B. (2003) Re-Os and U-Pb ages for the Butte copper district, Montana: a short- or long-lived hydrothermal system?: *Geological Society of America Abstract with Programs*, v. 34, no. 6, p. 400.

Perelló, J., Posso, H., Zárate, A., Neyra, C., Caballero, A., and Stein, H. (2003) Syntectonic Ag-rich porphyry copper mineralization at Pachagón, northern Peru: 10th Chilean Geological Congress, Concepción, Chile, October 6-10, 2003, Actas, Departamento Ciencias de la Tierra, Universidad de Concepción, p. 77-78.

Stein, H.J., Markey, R.J., and Hannah, J.L. (2003) Power in partnership: Re-Os molybdenite and U-Pb zircon dating, Goldschmidt Conference (invited lecture): *Geochimica et Cosmochimica Acta*, v. 67, no. 18 (S1), p. A445.

Stein, H.J., Markey, R.J., and Hannah, J.L. (2003) Dating young molybdenites and LLHR samples using Re-Os: the pitfalls and overcoming them: *Geochimica et Cosmochimica Acta*, v. 67, no. 18 (S1), p. A446.

Hannah, J.L., Stein, H.J., Bekker, A., Markey, R.J., and Holland, H.D. (2003) Chondritic initial $^{187}Os/^{188}Os$ in Paleoproterozoic shale (seawater) and onset of oxidative weathering: *Geochimica et Cosmochimica Acta*, v. 67, no. 18 (S1), p. A133.

Raith, J.G., Stein, H.J., Cornell, D.H., Langthaler, K.J., and Markey, R.J. (2003) Mo- and W-(Mo) deposits in pre-Alpine units of the Tauern Window: Re-Os and U-Pb constraints for two Variscan mineralization stages: GEODE-ABCD workshop, Seggauberg, Austria, March 22-24, published by *Institute of Geology and Paleontology, University of Salzburg*, p. 48-49.

Langthaler, K.J., Raith, J.G., Cornell, D.H., Stein, H.J., and Melcher, F. (2003) Geology and age of molybdenum mineralization at Alpeiner Scharte, Tyrol, Austria: *in* Vrána, S. (ed) Geology without Frontiers: Magmatic and Metamorphic Evolution of Central European Variscides: *Journal of the Czech Geological Society*, v. 48, no. 1-2, p. 87-88.

Stein, H.J. and Markey, R.J. (2003) New perspectives from old domains: intrusion-related Au in suspicious orogens, Eastern Goldfields, Yilgarn craton, Western Australia: *Geophysical Research Abstracts* (EGS-AGU-EUG joint assembly, 6-11 April 2003, Nice, France), v. 5, 07911 (electronic).

Stein, H.J., Zimmerman, A., Hannah, J.L., and Markey, R.J. (2003) Late Archean-Early Proterozoic timing for an Andean-style porphyry Cu-Mo deposit at Malanjkhand, Central Indian Tectonic Zone: implications for a Late Archean supercontinent: *Geophysical Research Abstracts* (EGS-AGU-EUG joint assembly, 6-11 April 2003, Nice, France), v. 5, 07496 (electronic).

Stein, H.J., Hallberg, A., and Perdahl, J.-A. (2003) Using Re-Os to distinguish metamorphic-metallogenic events and their economic value: an example from northern Sweden: *Geophysical Research Abstracts* (EGS-AGU-EUG joint assembly, 6-11 April 2003, Nice, France), v. 5, 07071 (electronic).

Zimmerman, A., Stein, H.J., Markey, R.J., Hannah, J.L., Sarkar, S.C., and Pal, A.B. (2002) Re-Os dating of the Malanjkhand Cu-(Mo) deposit in central India: tracking formation and deformation during the Late Archean-Early Proterozoic: *Geological Society of America Abstracts with Programs*, v. 34, no. 6, p. 187.

Stein, H. and Bingen, B. (2002) Re-Os dating of Cu-Mo mineral occurrences provides chronology of metamorphism and deformation for a supracrustal sequence in south Norway: *Geological Society of America Abstracts with Programs*, v. 34, no. 6, p. 42.

Markey, R., Morgan, J., Stein, H., and Hannah, J. (2002) A double-Os spike for molybdenite geochronology: *Geological Society of America Abstracts with Programs*, v. 34, no. 6, p. 340.

Jercinovic, M.J., Gillerman, V.S., and Stein, H.J. (2002) Application of microprobe geochronology to hydrothermal monazite and thorite, Lemhi Pass district, Idaho: *Geological Society of America Abstracts with Programs*, v. 34, no. 6, p. 172.

Gillerman, V.S., Jercinovic, M.J., and Stein, H.J. (2002) U-Pb and Re-Os geochronology suggest a multistage Precambrian-Mesozoic history for thorium and copper mineralization, Lemhi Pass, Idaho: *Geological Society of America Abstracts with Programs*, v. 34, no. 6, p. 337.

Stein, H.J. (2002) Re-Os dating: ore geology and beyond: *XI Congreso Peruano de Geología, Resúmenes, Sociedad Geológica del Perú*, p. 110.

Bingen, B. and Stein, H. (2002) Molybdenite Re-Os dating of regional deformation and granulite-facies metamorphism, Rogaland-Vest Agder, S Norway: symposium in honour of Jean-Clair Duchesne's retirement, "Modeling of magma chambers and implications for the evolution of the continental crust", University of Liège, Belgium, 3-5 September 2002 (Jacqueline Coppen-Vander Auwera, convenor), abstract volume, p. 7.

Wiszniewska, J., Duchesne, J.C., Vander Auwara, J., Claesson, S., and Stein, H. (2002) Proterozoic anorthosite intrusions and related Fe-Ti deposits in northeastern Poland: isotope and geochemical constraints on their origin: symposium in honour of Jean-Clair Duchesne's retirement, "Modeling of magma chambers and implications for the evolution of the continental crust", University of Liège, Belgium, 3-5 September 2002 (Jacqueline Coppen-Vander Auwera, convenor), abstract volume, p. 38-39.

Hannah, J., Stein, H., Zimmerman, A., Markey, R., Sarkar, S.C., and Pal, A.B. (2002) Late Archean-Early Proterozoic formation and reworking of a porphyry Cu-(Mo) deposit recorded in molybdenite: Re-Os dating at Malanjkhand, central India: *Geochimica et Cosmochimica Acta*, v. 66, no. 15A, p. A308. (Goldschmidt Conference)

Stein, H., Sillitoe, R., and Perelló, J. (2002) Discerning the lifespan of a giant porphyry Cu deposit: Re-Os dating at Los Pelambres, Chile: *Geochimica et Cosmochimica Acta*, v. 66, no. 15A, p. A738. (Goldschmidt Conference)

Bingen, B. and Stein, H. (2002) Molybdenite Re-Os dating of biotite dehydration melting: the Rogaland granulites, S Norway: *Geochimica et Cosmochimica Acta*, v. 66, no. 15A, p. A78. (Goldschmidt Conference)

Requia, K., Fontboté, L., Stein, H., and Chiaradia, M. (2002) Age and evolution of the Salobo iron oxide copper-gold hydrothermal system, Carajás Mineral Province, northern Brazil: *Global Exploration 2002: Integrated Methods for Discovery, SEG (Society of Economic Geologists) Meeting*, Denver (April 14-16), abstract volume, p. 133.

Stein, H.J. and Markey, R.J. (2001) Re-Os dating of Archean orogenic Au deposits in the Yilgarn, Western Australia: *Geological Society of America Abstracts with Programs*, v. 33, no. 6, p. A-130.

Hannah, J.L., Scherstén, A., and Stein, H.J. (2001) Re-Os behavior in mafic magmas and terrestrial diagenetic materials: extracting information from open systems: *Geological Society of America Abstracts with Programs*, v. 33, no. 6, p. A-238.

Schrader, C.M., Crowe, D., Turner, K., and Stein, H.J. (2001) $^{40}Ar/^{39}Ar$ and Re-Os geochronology of the Pebble Copper Cu-Au-Mo porphyry deposit, southwest Alaska: *Geological Society of America Abstracts with Programs*, v. 33, no. 6, p. A-418.

Witt, W., Stein, H., Cassidy, K., Black, L., Champion, D., and Fletcher, I. (2001) A >2.75 Ga basement enclave at Leonora: a domain of uplift and 2.75 Ga gold within 2.71-2.66 Ga Eastern Goldfields Province: *Exploration Dynamics, An AGU Chapman Conference*, Dunsborough, Western Australia, p. 176-177.

Taylor, B.E., Hannah, J.L., and Stein, H.J. (2001) Volatile history of the Mount Emmons porphyry molybdenum deposit, Colorado, inferred from O-H-S-C-Pb isotope systematics: *EOS, Transactions, American Geophysical Union*, v. 82, no. 20, p. S437.

Hannah, J.L. and Scherstén, A. (2001) Open-system behavior of Re and Os in uraninite, pyrite, and organic material in continental sedimentary rocks, Grants uranium region, New Mexico: *Geological Society of America Abstracts with Programs*, v. 33, no. 5, p. A-57.

Stein, H.J. and Sims, P.K. (2001) Mesoproterozoic magmatism in the Colorado Province: synchronous shearing and magmatism at 1430 Ma in the Climax and Empire regions, and younger magmatism at 1410 Ma in the Transition Zone: *Geological Society of America Abstracts with Programs*, v. 33, no. 5, p. A-10.

Sims, P.K. and Stein, H.J. (2001) Tectonic history of the Proterozoic Colorado Province, Southern Rocky Mountains: *Geological Society of America Abstracts with Programs*, v. 33, no. 5, p. A-4.

Stein, H.J. (2001) A comparison of the ^{187}Re-^{187}Os and $^{40}Ar/^{39}Ar$ chronometers in the ore-forming environment: *Journal of Conference Abstracts (EUG-11)*, Cambridge Publications, v. 6, p. 262.

Stein, H.J. and Markey, R.J. (2001) Re-Os dating of orogenic gold deposits, Yilgarn, Western Australia: *Journal of Conference Abstracts (EUG-11)*, Cambridge Publications, v. 6, p. 266.

Stein, H., Vokes, F.M., Cook, N., Bingen, B., and Ciobanu, C. (2001) Re-Os dating and a possible metamorphic origin for the Langvatn Cu-Mo sulfide deposits, Setesdalsheiene, southern Norway: *Journal of Conference Abstracts (EUG-11)*, Cambridge Publications, v. 6, p. 271.

Raith, J.G., Stein, H., and Höll, R. (2001) Re-Os ages for molybdenite from the Felbertal tungsten deposit, Tauern window, Austria: *Journal of Conference Abstracts (EUG-11)*, Cambridge Publications, v. 6, p. 263.

DeBraeckeleer, L., Becker, H., Hornish, M., Morgan, J.W., and Stein, H.J. (2000) Search for a time variation of the weak interaction constant using a geochemical determination of the $\beta\beta$-decay rate of ^{100}Mo, *in* Time Dependence of Fundamental Constants, Triangle Universities Nuclear Laboratory (TUNL) Progress Report – XXXIX, 1 September 1999 – 31 August 2000, p. 95-96.

Stein, H.J., Becker, H., DeBraeckeleer, L., Hornish, M., and Morgan, J.W. (2000) Time variation of the weak interaction constant: collection of molybdenite samples, *in* Time Dependence of Fundamental Constants, Triangle Universities Nuclear Laboratory (TUNL) Progress Report – XXXIX, 1 September 1999 – 31 August 2000, p. 101-103.

Morgan, J.W., Becker, H., DeBraeckeleer, L., Hornish, M., and Stein, H.J. (2000) Time variation of the weak interaction constant: ruthenium mass spectrometry, *in* Time Dependence of Fundamental Constants, Triangle Universities Nuclear Laboratory (TUNL) Progress Report – XXXIX, 1 September 1999 – 31 August 2000, p. 100-101.

Morgan, J.W., Becker, H., DeBraeckeleer, L., Hornish, M., and Stein, H.J. (2000) Time variation of the weak interaction constant: ruthenium separation chemistry, *in* Time Dependence of Fundamental Constants, Triangle Universities Nuclear Laboratory (TUNL) Progress Report – XXXIX, 1 September 1999 – 31 August 2000, p. 99-100.

Morgan, J.W., Becker, H., DeBraeckeleer, L., Hornish, M., and Stein, H.J. (2000) Time variation of the weak interaction constant: dissolution and equilibration methods and a ruthenium spike calibration, *in* Time Dependence of Fundamental Constants, Triangle Universities Nuclear Laboratory (TUNL) Progress Report – XXXIX, 1 September 1999 – 31 August 2000, p. 97-99.

Morgan, J.W., Becker, H., DeBraeckeleer, L., Hornish, M., and Stein, H.J. (2000) Time variation of the weak interaction constant: Re-Os geochronology of molybdenite, *in* Time Dependence of Fundamental Constants, Triangle Universities Nuclear Laboratory (TUNL) Progress Report – XXXIX, 1 September 1999 – 31 August 2000, p. 96-97.

Stein, H.J., Markey, R.J., Morgan, J.W., Williams-Jones, A.E., Heiligmann, M., and Clark, J.R. (2000) Re-Os age for the Hemlo Au (Mo) deposit, Ontario, Canada: *Geological Society of America Abstracts with Programs*, v. 32, no. 7, p. A-424.

Scherstén, A., Morgan, J.W., and Markey, R.J. (2000) Re-Os isotope systematics of Proterozoic arc cumulates: *Geological Society of America Abstracts with Programs*, v. 32, no. 7, p. A-346.

Hannah, J.L., Scherstén, A., Morgan, J.W. (2000) What can the Re-Os isotopic system tell us about diagenetic processes in continental environments? Quite a bit!: *Geological Society of America Abstracts with Programs*, v. 32, no. 7, p. A-346.

Bucci, L.A., Hagemann, S.G., Groves, D.I., McNaughton, N.J., and Stein, H.J. (2000) The link between Archean orogenic lode-gold and gold-skarn? An example from the Yilgarn craton, Western Australia: *Geological Society of America Abstracts with Programs*, v. 32, no. 7, p. A-425.

Stein, H.J., Markey, R.J., and Morgan, J.W. (2000) Robust Re-Os molybdenite ages for the Hemlo Au deposit: *Journal of Conference Abstracts (Goldschmidt 2000)*, v. 5, no. 2, p. 955.

Kosler, J., Cox, R., Sylvester, P., Wilton, D., Stein, H., and Scherstén, A. (2000) Laser ablation ICP-MS analysis of molybdenite – implications for Re-Os geochronology: *Journal of Conference Abstracts (Goldschmidt 2000)*, v. 5, no. 2, p. 601.

Hannah, J.L., Morgan, J.W., and Scherstén, A. (2000) Re-Os systematics in diagenetic pyrite from continental sedimentary rocks: potential for geochronology and isotopic tracer studies: *Journal of Conference Abstracts (Goldschmidt 2000)*, v. 5, no. 2, p. 481.

Morgan, J.W., Walker, R.J., Brandon, A.D., and Horan, M.F. (2000) Siderophile elements in Earth's upper mantle and lunar breccias: manifestations of the same late influx: *Journal of Conference Abstracts (Goldschmidt 2000)*, v. 5, no. 2, p. 718.

Stein, H.J., Morgan, J.W., Markey, R.J., and Hannah, J.L. (2000) Re-Os dating of Archean to Cenozoic ore deposits: an overview of successful studies: *31st International Geological Congress*, Abstract Volume on CD-ROM.

Hannah, J.L. and Stein, H.J. (2000) Os isotopes require crustal source for sulfide enrichment in Proterozoic anorthosite complexes: *31st International Geological Congress*, Abstract Volume on CD-ROM.

Hannah, J.L. and Stein, H.J. (2000) Re-Os model for genesis of anorthosite-hosted sulfide ores by assimilation of crustal sulfides: *EOS, Transactions, American Geophysical Union*, v. 81, no. 19, p. S434.

Ciobanu, C.L., Stein, H.J., and Cook, N.J. (2000) A Re-Os age for molybdenite, Dognecea skarn deposit, Banat, Romania: Geodynamics and Ore Deposits Evolution of the Alpine-Balkin-Carpathian-Dinaride Province, *ABCD-GEODE Workshop*, Borovets, Bulgaria, p. 19.

Ash, C.H., Reynolds, P.H., Friedman, R.M., Riveros, C.P., and Stein, H.J. (2000) Age and structural development of Cu-Mo mineralization at the Gibraltar mine, east central British Columbia: *Geological Society of America Abstracts with Programs*, v. 32, no. 6, p. A-2.

Stein, H.J., Morgan, J.W., Markey, R.J., Williams-Jones, A.E., Heiligmann, M., and Clark, J.R. (1999) Re-Os age for the Hemlo Au deposit, Ontario, Canada: Durability of the Re-Os chronometer: *EOS, Transactions, American Geophysical Union*, v. 80, no. 46, p. F1082.

Markey, R.J., Stein, H.J., Morgan, J.W., Hannah, J.L. (1999) Comparison of alkaline fusion versus Carius tube digestion for Re-Os dating of molybdenite: lessons from the Aittojärvi, Finland standard: *Geological Society of America Abstracts with Programs*, v. 31, no. 7, p. A-95.

Stein, H.J., Morgan, J.W., and Sundblad, K. (1999) Re-Os dating of low-level, highly radiogenic samples: a ^{187}Re-^{187}Os pyrite-chalcopyrite isochron for the Harnäs Au deposit in Sweden: *Geological Society of America Abstracts with Programs*, v. 31, no. 7, p. A30-31.

Watanabe, Y., Stein, H.J., Morgan, J.W., and Markey, R.J. (1999) Re-Os geochronology brackets timing and duration of mineralization for the El Salvador porphyry Cu-Mo deposit, Chile: *Geological Society of America Abstracts with Programs*, v. 31, no. 7, p. A-30.

Sims, P.K. and Stein, H.J. (1999) Re-Os ages for molybdenite record major Proterozoic crust-forming event in Colorado: *Geological Society of America Abstracts with Programs*, v. 31, no. 7, p. A-260.

Stein, H.J., Morgan, J.W., and Robert, F. (1999) ^{187}Re-^{187}Os dating of Archean Au deposits in the Val d'Or district, Abitibi belt, Quebec: *EOS, Transactions, American Geophysical Union*, v. 80, no. 17, p. S376.

Morgan, J.W. (1999) Double ^{188}Os-^{190}Os spike for Re-Os age determinations in molybdenites and other highly radiogenic sulfides: *EOS, Transactions, American Geophysical Union*, v. 80, no. 17, p. S376-S377.

Wiszniewska, J., Duchesne, J-C., Claesson, S., Stein, H., and Morgan, J. (1999) Geochemical constraints on the origin of the Suwalki anorthosite massif and relted Fe-Ti-V ores, NE Poland: Between Eurobridge and Tesz (Abstract Volume), *Seventh Eurobridge Workshop*, Polish Geological Institute, Warsaw, p. 89-91.

Stein, H.J., Morgan, J.W., Hannah, J.L., Markey, R.J., and Wiszniewska, J. (1999) Crustal origin for oxide-sulfide ores and anorthosite: Re-Os evidence from the Suwalki massif, northeast Poland: *Journal of Conference Abstracts (EUG-10),* Cambridge Publications, v. 4, no. 1, p. 688.

Stein, H.J., Markey, R.J., Sundblad, K., Sivoronov, A.A., Bobrov, A.B., and Merkushin, I.E. (1999) Precise ^{187}Re-^{187}Os ages for Au deposits in the Ukrainian shield: *Journal of Conference Abstracts (EUG-10),* Cambridge Publications, v. 4, no. 1, p. 500.

Raith, J.G., Stein, H.J., and Finger, F. (1999) Timing and duration of high-grade metamorphism in western Namaqualand, South Africa: *Journal of Conference Abstracts (EUG-10),* Cambridge Publications, v. 4, no. 1, p. 462-463.

Scherstén, A., Morgan, J.W., and Markey, R.J. (1999) ^{187}Re-^{187}Os isotopic and abundance systematics of Proterozoic volcanic arc derived ultramafic cumulates from SW Sweden: *Journal of Conference Abstracts (EUG-10),* Cambridge Publications, v. 4, no. 1, p. 805.

Stein, H.J., Morgan, J.W., Markey, R.J., Sundblad, K., Sivoronov, A.A., Bobrov, A.B., Malyuk, B.I., and Pavlun, M.M. (1998) ^{187}Re-^{187}Os ages for molybdenites from the Archean Maiske and Sergeevske Au deposits, Ukraine: *EOS, Transactions, American Geophysical Union,* v. 79, no. 45, p. F-933.

Starkey, N.K., Stein, H.J., Hannah, J.L., and Sundblad, K. (1998) Secondary hematite: evidence for molybdenum transport under oxidizing conditions, Bergslagen district, Sweden: *Geological Society of America Abstracts with Programs,* v. 30, no. 7, p. A-76.

Stein, H.J., Morgan, J.W., Markey, R.J., and Wiszniewska, J. (1998) A Re-Os study of the Suwalki anorthosite massif, northeast Poland: *Geological Society of America Abstracts with Programs*, v. 30, no. 7, p. A-20.

Zák, K. Durisova, J., Strnad, L., Golias, V., Leach, D.L., Snee, L.W., Viets, J., Stein, H.J. (1998) The evolution of pressure temperature and composition of hydrothermal fluids in a regional shear zone during retrograde metamorphism, regional uplift, and cooling; the Kasperske Hory gold deposit case study (Bohemian Massif, Czech Republic): PACROFI – Pan-American Conference on Research on Fluid Inclusions Program and Abstracts, v. 7, p. 73.

Stein, H.J., Markey, R.J., Morgan, J.W., Hannah, J.L., Zák, K., and Zachariáš, J. (1997) Re-Os dating of gold deposits using accessory molybdenite at the Kašperské Hory and Petráckova Hora mines, Czech Republic: *Journal of the Czech Geological Society*, v. 42, no. 3, p. 26.

Stein, H.J., Markey, R.J., Morgan, J.W., Sundblad, K., and Larin, A. (1996) Re-Os dating of molybdenite: New tools, new applications, new interpretations -- an example from Karelian Russia: *EOS, Transactions, American Geophysical Union,* v. 77, no. 46, p. F-773-774.

Stein, H.J., Markey, R.J., Morgan, J.W., Zák, K., Zachariáš, J., and Sundblad, K. (1996) Re-Os dating of Au deposits in shear zones using accessory molybdenite: Bohemian Massif, Carolina Slate Belt, & Fennoscandian Shield examples: *Geological Society of America Abstracts with Programs*, v. 28, no. 7, p. A-474.

Stein, H.J., Sundblad, K., Markey, R.J., and Morgan, J.W. (1996) New tools, new interpretations: A Re-Os revealation at the skarn deposits of Pitkäranta, Russia: *Journal of Conference Abstract (V.M. Goldschmidt Conference)*, Cambridge Publications, v. 1, no. 1, p. 594.

Stein, H.J., Markey, R.J., and Morgan, J.W., Sundblad, K., and Kouvo, O. (1995) Precise Re-Os dating of molybdenites, fusion chemistry and NTIMS: A summary of examples from Archean to Late Paleozoic: *EOS, Transactions, American Geophysical Union*, v. 76, no. 46, p. F-713.

Stein, H.J., Sundblad, K., Markey, R.J., and Morgan, J.W., and Kouvo, O. (1995) Precise dating with the Re-Os method: Molybdenites from tonalites in Fennoscandian Shield track Archean metamorphism or cooling history: *Geological Society of America Abstract with Programs*, v. 27, no. 6, p. A-281.

Markey, R.J., Stein, H.J., and Morgan, J.W. (1995) Highly precise Re-Os age for molybdenite using alkali fusion and NTIMS*: Geological Society of America Abstracts with Programs*, v. 27, no. 6, p. A-281.

Stein, H.J., Hofstra, A.H., Snee, L.W., Morgan, J.W., Walker, R.J., and Dahl, A.R. (1994) Preliminary Re-Os data from the Carlin-type gold deposits in the Jerritt Canyon district, Nevada: *Geological Society of America Abstracts with Programs*, v. 26, no. 76, p. A-141.

Stein, H.J., Morgan, J.W., Walker, R.J., and Horan, M.F. (1993) A mantle component for Climax-type granite-molybdenum systems or our first glimpse at Re-Os in the lower continental crust: *EOS, Transactions, American Geophysical Union*, v. 74, no. 16, p. 121.

Stein, H.J., Morgan, J.W., Walker, R.J., and Horan, M.F. (1992) Rhenium-osmium data for sulfides and oxides from Climax-type granite-molybdenum systems: Mount Emmons, Colorado: *Geological Society of America Abstracts with Programs*, v. 24, no. 7, p. A-144.

Other Miscellaneous Publications:

Stein, H.J. (2015) “Top science for sale”, an invited editorial on the history of the AIRIE Program (Founder and Director of the AIRIE Program discusses how a small upstart group blossomed into a research team now well known to Europe but on the skids in the USA): *Pan European Networks, Science & Technology*, Issue 15, p. 192-193.

Holt, C. (2014) “Oils, ores, and climate crises”, a profile on Holly Stein (CEED explains why a radiometric clock monitored by elements Re (rhenium) and Os (osmium) is at the heart of aiding climate crisis: *Pan European Networks, Science & Technology*, Issue 13, p. 232-233.

Laggan, S. (2014) Oil, Meteorites, and Metals – interview with Holly Stein, *International Innovation*, Research Media Ltd, Bristol, UK, Issue 145, p. 101-103.

Trembley, P., managing editor (2007) Helmholtz-Humboldt research award to Holly Stein: *Elements*, v. 3, no. 4, p. 230.

Stein, H.J. (2006) Acceptance of the SEG Silver Medal for 2005 (citation by Robert A. Creaser): *Economic Geology*, v. 101, p. 716-719.

Bingen, B., Eide, E., and Stein, H., *guest editors* (2006) Geochronology of orogenic processes: Crystal-chemical to continental scale interpretations: *Lithos*, v. 87 (editorial to special volume), p. v-vii.

Stein, H.J. and Hannah, J.L. (2006) An ore deposit from underside up: a collaborative deep-underground lab: *SEG Newsletter*, no. 64 (January 2006), p. 18-19.

Stein, H.J. (2006) Invited Commentary on "Rhenium-osmium geochronology of arsenopyrite in Meguma group gold deposits, Meguma Terrane, Nova Scotia, Canada: evidence for multiple gold mineralizing events" by Morelli, R.M., Creaser, R.A., Selby, D., Kontak, D.J., Horn, R.J. – An Invited Commentary on Journal Papers: *SEG Newsletter*, no. 64 (January 2006), p. 24-25.

Stein, H.J. (2006) SGA takes on new opportunities with other societies: *SGA Newsletter*, no. 20 (March 2006), p. 28-29.

Stein, H.J. (2002) Book Review of Paleozoic Porphyry Molybdenum-Tungsten Deposit in the Myszków Area, Southern Poland, Polish Geological Institute Special Papers, no. 6, p. 1-88: Book Review for *International Geology Review*, v. 44, p. 477-478.