Petroleum as source and carrier of metals in epigenetic sediment-hosted mineralisation

N.J. SAINTILAN[1,5,*], J.E. SPANGENBERG[2], M. CHIARADIA[1], C. CHELLE-MICHOU[1,6], M.B. STEPHENS[3,4], L. FONTBOTÉ[1]

[1]Department of Earth Sciences, University of Geneva, Rue des Maraîchers 13, 1205 Geneva, Switzerland (*correspondence: saintilanic@gmail.com)
[2]Institute of Earth Surface Dynamics, University of Lausanne, Building Geopolis, 1015 Lausanne, Switzerland
[3]Geological Survey of Sweden (SGU), Box 670 SE-751 28 Uppsala, Sweden
[4]Division of Geosciences, Luleå University of Technology, SE-971 87 Luleå, Sweden
[5]Department of Earth Sciences, University of Durham, Durham DH1 3LE, UK
[6]School of Earth Sciences, University of Bristol, Will Memorial Building, Queens Road, Bristol BS8 1RJ, UK

Geological and organic geochemical constraints indicate that petroleum produced from the middle Cambrian to Lower Ordovician Alum Shale Formation was involved in the formation of the 467 Ma old world-class Pb-Zn sulphide sandstone-hosted mineralisation of Laisvall (Sweden) [1,2].

Using complementary organic extraction procedures and aqueous lead isotope geochemistry, we show that lead originally found in the bitumen of the Alum Shale Formation was transported several tens of kilometres eastwards during an arc-continent collisional event [1,2] by liquid petroleum and associated brines to the mineralisation site in Ediacaran to Cambrian sandstone at Laisvall. This “petroleum-associated lead” was subsequently made available for precipitation as sulphides when the organic phase was altered in the process of thermochemical sulphate reduction (TSR) with hydrocarbons acting as a source for hydrogen and CO_2, thereby changing the acidity. This “petroleum-associated lead” makes up 40 to 60% of this metal in the deposit, the remainder having been leached from basement rocks by basinal brines. Our data are consistent with experimental work focusing on fluid-oil interaction and metal solubility of organic compounds [3]. The data record for the first time how petroleum and associated brines are key for ore formation not only by making available reduced sulphur via TSR but also by contributing with significant metal amounts.

[1] Saintilan et al. (2015) *Econ Geol* **110**, 1779–1801
[2] Saintilan et al. (2016) *Miner Deposita* **51**, 639–664
[3] Giordano T.H. (2002) *Geochem Transac* **3**, 56–72

This abstract is too long to be accepted for publication. Please revise it so that it fits into the column on one page.