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Ores and Climate Change - Primary Shareholders

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Many in the economic geology community concern themselves with details of ore formation at the deposit scale, whether tallying fluid inclusion data to get at changes in ore-forming fluids or defining structures that aid and abet mineralization. These compilations are generally aimed at interpretation of events at the site of ore formation, with the goal being assignment of the deposit to a sanctioned ore deposit model. While providing useful data, this approach is incomplete and does not, by itself, serve present-day requirements for true interdisciplinary science.

The ore-forming environment is one of chaos and disequilibrium at nearly all scales (Stein, 2014). Chaos and complexity are documented by variably altered rocks, veins or disseminated mineralization with multi-generational fluid histories, erratic and unusual textures in host rocks, and the bitumen or other hydrocarbon products entwined within many ore deposits. This should give pause to our drive for more data as a means to find "the answer". The answer lies in the kind of data collected and more importantly, in the way we interpret those data.

Rather than constructing an ever-increasing catalog of descriptive mutations on sanctioned ore deposit models (e.g., IOGC or Iron-Oxide Copper Gold deposits), the way forward is to link source and transport of metals, sulfur, and organic material with regional and ultimately whole Earth chemical evolution. Important experimental work provides chemical constraints in controlled and behaved environments. To these data, we add imagination and interpretation, always tying back to field observations.

In this paper, several key points are made by way of ore deposit examples: (1) many IOCG deposits are outcomes of profound changes in the chemistry of the Earth's surface, in the interplay of the atmosphere, hydrosphere, biosphere, and lithosphere; (2) the redox history of Fe in deep earth may be ultimately expressed in the ore-forming sequence; and (3) the formation of many giant Cu-Mo-Au ore deposits may be arrested when the surface is catastrophically breached, as multiple km-scale breccia pipes empty their volatile and metal contents into the atmosphere. The new equation for studying ore geology should be one that reconstructs ore formation from beginning to end, that is, from source, release, and transport, to breach. Of course, detailed measurements and mapping of ore bodies remains essential, but a full understanding of metal migration and budgets can only be achieved if we model what might have been left behind in deeper Earth, and what may have been lost to the atmosphere. To do this, we need to understand much more than the geology at our ore deposit of interest.

Stein, H.J. (2014) Dating and Tracing the History of Ore Formation. Treatise on Geochemistry 13: 87-118. Elsevier. Support for time to think – CHRONOS, funded by a consortium of Norwegian petroleum companies.