THE ORIGIN OF ORE-FORMING FLUIDS IN MESOTHERMAL LODE GOLD DEPOSITS: AN OVERVIEW WITH NEW N-ISOTOPE CONSTRAINTS

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Mesothermal gold-bearing quartz vein systems constitute one of the most important classes of precious metal deposits; they occur accretionary orogenic belts of Archean to Cenozoic age. The chemistry of the ore-forming fluids and the late orogenic timing of the deposits are remarkably similar through time and space. However, their origin remains controversial after many decades of research. Several contrasting genetic models have been proposed including mantle, granitoid, meteoric water, and metamorphic-derived ore fluids, based on various lines of geochemical evidence (mainly H, O, C, and S isotope studies) from different deposits. Collectively, the results are not unambiguous, given some resetting and overlapping of 'characteristic fields'.New N and nitrogen isotope data on hydrothermal muscovite have been obtained from the Archean Superior Province of Canada, and biotite from nine Au deposits of the Norseman-Wiluna greenstone belt, Western Australia. The majority of muscovites and biotites have N contents of 20-190 ppm and d15N of 10‰-20‰, and 10-70 ppm and 10‰-24 ‰, respectively. The d15N of the mantle is –5‰, and of granitoids is 0‰-10‰, both with generally low N contents; organic N is 0‰-10‰; meteoric water is 1.9‰-9.4‰; and metamorphic rocks are 3‰ to 18‰, increasing with higher grade. Accordingly, the data appear to rule out a mantle hypothesis, granitoid-related magmatic processes, or meteoric water for the deposits, but are consistent with ore-fluids derived by metamorphic dehydration reactions.