6.4.P06

REE signature, Sm-Nd and Rb-Sr isotope systematics of scheelites from the Woxi Au-Sb-W deposit in Western Hunan, South China

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There are many gold and antimony deposits in Western Hunan, South China. Among them, the Woxi Au-Sb-W deposit is the largest. The ore-bearing quartz veins in the Woxi deposit are usually concordant with the Proterozoic slate. The magmatic activities are extremely weak in this area, no igneous rocks occur in the mining district.

Scheelite is a common mineral in the Woxi deposit, it usually appears anhedral grain or massive aggregate; the irregular fine-grained scheelite is disseminated in quartz vein, the latter is usually cut by quartz veinlets.

The scheelites contain considerable concentrations of rare earth elements, with the ΣREE+Y contents in the range of 40.5 to 123.6 ppm. The chondrite-normalized REE pattern of seven scheelite samples is characterized by LREE-depleted, MREE- and HREE-enriched, and large Sm/Nd ratios. The crystallographic control by scheelite is probably responsible for the hump-shaped pattern.

Sm contents for the disseminated scheelites range from 2.23 ppm to 6.20 ppm, and its Nd contents vary in the range of 1.86-4.54ppm. The $^{147}Sm/^{144}Nd$ and $^{143}Nd/^{144}Nd$ ratios for disseminated scheelites fall in the range of 0.6409-1.0749 and 0.512229-0.513372, respectively. In the $^{147}Sm/^{144}Nd$-$^{143}Nd/^{144}Nd$ diagram, the disseminated scheelites show a good linear array, which corresponds to an isochron age of 402±6 Ma and an initial $^{143}Nd/^{144}Nd$ ratio of 0.510544±9 (2σ). This result coincides well with the ^{40}Ar-^{39}Ar data of two auriferous quartz samples from the same deposit. Thus, the Au-Sb-W mineralization in this deposit took place during Late Caledonian Period rather than Xuefeng Period (about 800 Ma) as previously expected.

All the scheelites have less than 2.2 ppm Rb, but the Sr contents are relatively high and variable, ranging from 1455-6810ppm. The $^{87}Sr/^{86}Sr$ ratios of the scheelites vary in the range of 0.7468 to 0.7500, significantly rich in radiogenic ^{87}Sr in contrast to those scheelites previously reported in the literature.

In comparison to the ε_{Nd} (*t*) values of the Proterozoic strata outcropped in this area, the $\varepsilon^{i}_{Nd}(t)$ of scheelites is significantly low. And the $^{87}Sr/^{86}Sr$ ratios for scheelite are markedly higher those of the host Proterozoic strata (less than 0.720). Thus, there exists an additional Nd and Sr source for the ore-forming fluid responsible for the Woxi deposit except the host Proterozoic strata, probably the underlying Archaean continental basement is most likely candidate available.

6.4.P07

Hydrogen flux from the Earth's core giant ore deposits and related phenomena through Earth history

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Most models of ore deposit formation are based on some combination of relatively common Earth processes operating in the middle to upper crust. Extant models explain most achitectural and geochemical properties at the deposit scale but fail to account for the spatial and temporal distribution of ore deposits and provinces through Earth history. One of the significant unresolved issues is the source(s) of the H_2 and H_2S required to sustain chemical gradients in redox and S activity to form large tonnage, high grade base and precious metal deposits. But there is increasing isotopic evidence (S, Pb, Os, Nd, noble gases) for mantle and/or deep-crustal contributions in the porphyry deposits of Chile, the Proterozoic base metal deposits of Australia and Late Archean gold deposits, including the Witwatersrand gold deposits. The most reduced fluids in gold deposits of the Yilgarn Craton, Australia, formed at 500-700 ºC, are inferred to have been composed dominantly of H_2 - CH_4 - H_2S. It is suggested that mantle degassing of H_2 was key to the production of these reduced, anhydrous fluids.

Related Earth processes

H_2 degassing from the Earth's core provides a plausible mechanism for generation of wet spots in the mantle by reduction of carbon dioxide to methane and water and initiating the Wilson cycle. Diamond precipitation requires a CO_2/CH_4 gradient and this could be generated by a H_2-rich plume. A focused flux of core/mantle derived hydrogen through sedimentary basins would promote reduction of organic matter to oil and gas. Evidence of mantle-derived noble gas fluxes in sedimentary basins, provide some support for this, assuming the noble gases may be taken as proxies for H_2. Arguably, episodic release of hydrogen into the hydrosphere and atmosphere provides a plausible alternate explanation for periods of anoxia in the Earth's oceans and mass extinction events. Hydrogenous, PGE-bearing fluids could account for enrichment of these metals at the Tertiary – Cretaceous boundary just as they may be postulated to account for the enrichments observed in the high grade Au deposits of the Witwatersrand Basin, South Africa.