

Metal Recycling Recorded by Sulfide-Sulfosalt Inclusions in Paleoproterozoic Microcline Pegmatites, Tandilia Belt (Argentina), Río de la Plata Craton

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The mechanism responsible for metal remobilization during high-grade metamorphism remains debated whether low-melting chalcophile elements (LMCEs) and base- to precious metals are redistributed primarily by hydrothermal fluids or sulfide anatexis. In the Paleoproterozoic basement of the Tandilia Belt (TB), Río de la Plata Craton (RPC), widespread crustal anatexis associated with the Transamazonian cycle generated pegmatites that provide a natural setting to investigate metal-mobilizing processes. Here we document sulfide-sulfosalt inclusions (SSIs) hosted in microcline from these pegmatites, providing the first direct evidence for sulfide melting in the RPC. This study examines rounded to irregular SSIs, hosted within black and white microcline in pegmatites, to evaluate the role of sulfide anatexis in metal remobilization. Field observations, petrography, SEM-EDX, and Raman spectroscopy characterize the composition, abundance, and internal textures of single- and multiphase inclusions. SSIs are abundant within microcline crystals and occur in all studied pegmatites. Disseminated single-phase inclusions (10-50 μm) include galena, sphalerite, chalcopyrite, pyrite, molybdenite, pyrrhotite, bismuth and native gold. Multi-phase inclusions (50-200 μm) occur as clustered "pocket"-type aggregates and consist of chalcopyrite, pyrite, argentite, covellite, arsenopyrite, and molybdenite enriched in LMCEs (Ag, Sb, Bi, and As). Similar sulfide melt inclusions have been documented from metamorphosed ore systems worldwide, including Hemlo, Broken Hill, Xiaoqinling lode gold district, Aggeneys, Bodenmais, and Balmat. The observed rounded morphologies, multi-phase assemblages, pocket-type distributions, and LMCE enrichment are consistent with the entrapment of sulfide melt droplets within growing feldspar during pegmatite crystallization. Subsequent interaction with hydrothermal fluids likely contributed to localized redistribution and late-stage metal precipitation. These results indicate that sulfide anatexis in the RPC was the primary mechanism for metal remobilization during Paleoproterozoic high-grade metamorphism in the TB. The systematic occurrence of sulfide inclusions within microcline suggests that this mineral may serve as a useful indicator of metal remobilization processes in high-grade cratonic terranes.