Fe–Ti-oxides down to the nanoscale: ores from layered intrusions

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Fe–Ti–V-rich deposits associated with the Panzhihua layered intrusion, SW China, show μm-scale textural complexity in both Fe–Ti-ores and host silicate assemblages suggesting a protracted geological history [1]. HAADF-STEM study of FIB-prepared foils obtained from ores that record overprinting [titanomagnetite (Ti-Mt) with irregular boundaries against ilmenite (Ilm) and spinel (Spl); Fig. 1a] offers detailed insights down to the nanoscale. Typical of Ti-Mt re-equilibration upon cooling are μm-scale networks of trellis-like Ilm exsolutions with Spl nucleating at the junctions between differently-oriented sets of lamellae. Such early exsolutions are superimposed by nm-scale lamellae of Ti- and Al–Mg-species (Fig. 1b), indicating subtle changes in pre-existing phases. These include variable Al/Mg ratios in Spl, the Mg–Ti-spinel qandilite (Mg_2TiO_4; Qdl) and Ti-poor, V-rich magnetite relative to host Ti-Mt. The latter occur as lamellae nm- to tens-of-nm-wide crosscutting pre-existing exsolution trellis (Fig. 1c). Orientations between Ti-Mt and Ilm are offset across mutual scalloped boundaries but remain coherent between Ti-Mt and Spl outside this boundary. Our findings imply: (i) chemical-structural reworking of pre-existing Ti-Mt leading to local V enrichment; and (ii) a later Ilm generation replacing Ti-Mt. Results enable re-evaluation of the exsolution sequence among Fe-Ti-oxides and carry implications for the reliability/accuracy of physicochemical conditions calculated using Fe–Ti-oxide compositions. Enrichment of by-product V during overprinting is shown.

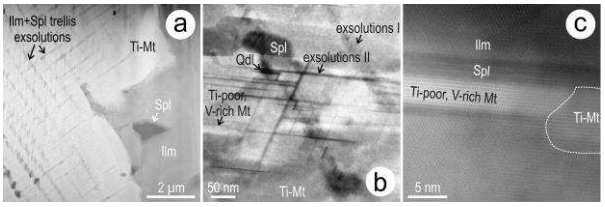

Fig. 1. HAADF-STEM images showing micron- to nm-scale aspects of Fe–Ti-oxides from ores in the Panzhihua layered intrusion. Images obtained at 200 kV (Titan Themis; Adelaide Microscopy).

[1] Gao, W.Y. et al. (2017) Lithos 294, 164-183.