# Unravelling the gold source of a Witwatersrand-type deposit: insights from mineral inclusions in rutile

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Rutile is an important accessory mineral that can be associated with gold mineralisation. Concentrations of W, Sb and V have been proposed as a discriminating proxy for identifying such rutiles. However, the potential of mineral inclusions in rutile has so far been overlooked. This could be particularly useful in assessing the nature of detrital gold.

The Quadrilátero Ferrífero in Brazil is known for its world-class sized deposits hosted by the greenstone belt (RdV), and for paleoplacer deposits hosted by the late Archean/Paleoproterozoic Moeda Formation (MF). The MF has been compared to the Witwatersrand basin where there has been a long-term debate over the nature of the gold and whether it is detrital (placer), hydrothermal or hybrid (modified placer). Presently, links between gold in the MF and RdV are tenuous. Here, we present a new approach using detrital rutile in the gold-bearing horizons of the MF. We show mineral chemistry, microstructural (intracrystalline textures) and isotopic (U-Pb) data collected by SEM (BSE, EDS, FSD and EBSD), EPMA and LA-ICPMS.

Grain textures (high porosity, patchy zoning) and mineral intergrowths have contributed to establishing a primary hydrothermal origin, related to As-Fe-Cu-Sb-Pb rich mineralising fluids. Sulphides and sulfosalts of these metals are commonly present in the RdV, and relate to the gold mineralisation. Samples show variation in the diversity and density of mineral inclusions/intergrowths, from Fe-Cu-As-Sb-rich to W-Cu-rich, which can be interpreted as different sourcing of rutile within the mineralising system.

FSD imaging and EBSD also provide insight into detailed textures, supporting a complex grain geometry and heterogeneity. The same was observed with trace/minor element compositions. The presence of micron-size zircon, xenotime and monazite could be evidence for dissolution and reprecipitation of rutile, exsolving the non-compatible elements during reequilibration at different P-T conditions.

U-Pb data yield older than deposition ages, supporting the detrital nature of the rutiles. Rutiles have experienced Pb-loss, suggestive of a ≈600Ma reworking event, potentially responsible for the gold remobilisation. Thus, this study seems to support a modified placer model for the MF, and confirm the use of rutile as a powerful tool to elucidate processes and provenance.