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A unifying model for tin mineralisation in granites–pegmatites–greisens and veins: an African perspective

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Although across Africa tin-bearing deposits range in age from Archaean to Mesozoic, with localised Pleistocene alluvial deposits, major eras of tin mineralisation related to continental amalgamation occurred in the early and late Neoproterozoic and related to the fragmentation of Gondwana during the Mesozoic.

Tin-bearing magmas generally have monzo- to syenogranite compositions. Primary cassiterite-hosting deposits require a combination of factors: (i) the generation of magma, (ii) ascent of the magma through structurally-controlled passageways, (iii) crystallisation of the magma with or without fluid separation, (iv) generation of a hydrothermal fluid phase, and (v) escape of a hydrothermal fluid. The style of tin deposits can be grouped into different categories based on whether, and when, a fluid phase separated from the magma:

(1) Zoned and unzoned pegmatites generated as small melt fractions without a parent granite at depth. Magmatic cassiterite may have crystallised at the pegmatitic stage or/and from later hydrothermal alteration of the pegmatite, including the formation of a greisen (Fuchsloch 2018).
(2) Disseminated mineralisation in granite cupolas where fluid was retained.
(3) Irregular greisenised or tourmalinised zones of a granite cupola where hydrothermal fluids separated from the magma before the ductile–brittle transition.
(4) Pipes, stockworks, sheeted veins and greisens within a granite cupola after the ductile–brittle transition.
(5) Exogranitic greisens and sheeted veins within the country rock with associated alteration of the country rock and localised occurrence of skarns.
(6) Later endo- or exogranitic quartz-rich cassiterite-wolframite bearing veins representing the last stage in fluid evolution.
(7) Metamorphic re-distribution of cassiterite into zones of altered host rock.
(8) Alluvial and eluvial deposits derived from any of the above cassiterite-bearing deposits.

Using examples from Namibia, Nigeria and South Africa, it is possible to show that the various styles of tin-bearing deposits can be viewed in a unified model depending on where the magma crystallised, whether a fluid phase evolved, and if so, whether this occurred before the ductile–brittle phase transition and whether the fluids breached the carapace and resulted in mineralisation in the country rocks.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Fuchsloch (2018) PhD, Univ. of the Witwatersrand

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A magmatic end member: the Mala volcanogenic massive sulphide (VMS) deposit, Troodos, Cyprus

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A variable magmatic volatile influx into subduction-related seafloor hydrothermal systems is hypothesised to explain variations in trace element compositions (de Ronde et al. 2005; Herzig, Hannington, et al.

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