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The Groenfontein and Zaaiplaats Tin Deposits – a model for the future of Tin Exploration?

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The granite-hosted Groenfontein and Zaaiplaats Tin Deposits are found towards the upper contact of late-stage, fractionated and hydrothermally altered granite pluton associated with the 2056 Ma Bushveld Complex, South Africa. They are suggested to have been formed as the result of fractional crystallisation of crustally-derived granites. Cassiterite mineralisation in pipe-like bodies, sub-horizontal lenticular bodies and as a sub-horizontal disseminated lower-grade bodies within both granites. Historical mining focused on high-grade (>1% Sn) mineralisation associated with pipe-like bodies and horizontal lenticular bodies, but recent exploration has focused on lower-grade (but still economically viable) disseminated cassiterite mineralisation.

According to the fractional crystallisation model, disseminated mineralisation is the result of in-situ crystallisation of evolved, tin-rich fluids that were unable to separate from the solid crystals and escape, whilst higher-grade pipes formed from escaped, trapped, tin-rich fluids. Recent exploration has focused on lower-grade (0.1-0.5% Sn) disseminated mineralisation within the granites. The existence and grade of this disseminated mineralisation is controlled by the degree of separation of fractionated fluids from the crystal mush.

Disseminated tin mineralisation is known from granite-hosted tin deposits elsewhere in the world (e.g. the Banke Complex, Nigeria and in late G4 granites, Rwanda). However, the vast majority of tin deposits are hosted in narrow, rich veins. Here we suggest that larger, lower-grade tin deposits in the roof zones of plutons may be present in many more plutons, and that these deposits could be easily targeted through systematic exploration and geochemical sampling, as demonstrated by case studies at Zaaiplaats and Groenfontein.