Driekop platinum pipe, Bushveld Complex, South Africa: New insights

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The genesis of the platiniferous pipes of the eastern Bushveld Complex is still enigmatic. Orthomagmatic, metasomatic replacement, and hydrothermal models were proposed (Scoon and Mitchell 2004), however, advance on the understanding of the pipes is hampered by the fact that these orebodies were mined out early in the last century and limited material is availble from museum collections only.

Our interest in the pipes was sparked off by investigations of detrital PGM in the Bushveld river systems (Oberthür *et al*. 2004). The present paper reports on a sample from the Driekop Pipe (Wilhelmskopje) collected in 1926 (TU Berlin) and highlights the impact of using novel methods of ore treatment on investigations especially of noble metal ores.

The greenish-greyish, dense sample is a medium-grained dunite with accessory disseminated chromite and has an ore grade of 34.9 ppm Pt. Contents of the other PGE and gold are all <1ppm. Ten polished sections investigated by ore microscopy and SEM yielded a disappointing number of only 5 PGM grains (>50 µm), underlining theoretical data (Ney 1977) on comparable gold ores that, at an average grain size of 100 µm and at a grade of 100 ppm, about 5-10 polished sections are needed to detect one discrete grain of gold.

Therefore, a combination of novel methods was tested on a slab of the sample weighing 676 grams, namely electric pulse disaggregation (EPD), hydoseparation (HS) and preparation of monolayer polished sections (5 size fractions between <63 and >400 µm) for further studies. The results were compelling: At least 500 PGM grains were found in the fractions. Grain sizes range from ~10-330 µm (most common around 100 µm). Many grains are composite. Sperrylite is the dominant PGM (ca. 90%), followed by Pt-Fe alloy and another twelve rarer PGM species. Notably, geversite (c.f. Melcher and Lodziak 2007) is absent. Analytical procedures and new data from our ongoing studies will be presented.

References

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Testing the hotspot record for evidence of broad melting anomalies

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The notion of a mantle plume has long been that of a mushroom-like 'head' (LIP) and thin 'tail' structure (hotspot chain) rising from a deep thermal boundary layer, generally depicted as the core-mantle boundary. Drifting of tectonic plates over the narrow, presumably fixed, hotspots created by such plume 'tails' has long provided an elegant explanation for time-progressive lines of islands, seamounts and ridges. But a major problem cited for this 'standard' plume model is a lack of evidence in the volcanic record for head-and-tail upwellings.

New evidence from direct dating of the oceanic hotspot record is also suggesting that hotspot melting anomalies might be much broader than commonly inferred from the 'head-tail' plume model and the dimensions of individual seamount chains and aseismic ridges. For example, new age data show that the Galapagos Volcanic Province developed via the progression of broad regions of concurrent dispersed volcanism that we link to a correspondingly broad mantle melting anomaly (O'Connor *et al.*, submitted, 2007). Moreover, recent thermo-chemical numerical modelling is exploring scenarios where upwelling structures are more irregular in shape and behaviour compared to a classic thermal plume 'head-tail' (*e.g.*, Farnetani and Samuel, 2006).

New strategies are therefore needed for investigating the hotspot volcanic record in order to better test the 'fixity' of hotspots and the mantle plume hypothesis. To this end we have recently sampled multiple seamount chains and ridges scattered across a broad region of the southern South Atlantic. Our focus is on investigating multiple hotspot chains stretching across a very broad region of the South Atlantic seafloor as a potentially useful way of testing 1) the new thinking that plume upwellings may differ from the classic 'head-tail' structure and 2) our evolving hypothesis that hotspot melting anomalies are much broader than suggested by regions of active volcanism marking the young ends of individual hotspot trails. A key component of this strategy is our IOPD proposal to drill Walvis Ridge once we have developed a fuller understanding of how Walvis Ridge fits with the predictions of the fixed hotspot and mantle plume hypotheses.