Decoupled hybrid boundary layers at the base of komatiite lava pathways: Omnipresent components of actively eroding lava pathways

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The Silver Swan and Cygnet nickel sulfide orebodies occur at the base of, and within, two lava pathways identified within the coeval sequence of komatiite/dacite lavas of the Archaean Black Swan Succession 50km NNE of Kalgoorlie, Western Australia. In addition to the ore accumulations, komatiite lithologies occupy the lava pathways forming a series of overlapping lobes of sago-, wormy- and bimodal-textured olivine orthocumulates and mesocumulates, with scattered disseminated sulfide.

A basal hybrid boundary layer up to two metres thick forms an omnipresent contact zone between the Cygnet lava pathway and underlying dacite lavas. This boundary layer consists of a mixture of partially melted and recrystallised fragments and digitate protrusions of footwall dacite and fine-grained contaminated komatiite which forms a felted groundmass (xenomelt). This hybrid boundary layer grades upwards into a mixed rock zone which is up to 6m thick and composed of variable medium-grained olivines with a variety of crystal morphologies, fragments of olivine mesocumulate, rare pyroxene oikocrysts, and ragged clots of sulfide which form a loosely-packed olivine orthocumulate which has an acicular plumose groundmass. The basal hybrid boundary layer and overlying “mixed rock” zone exhibit elevated but erratic Zr/Ti ratios corresponding to fluctuating degrees of contamination and hybridisation.

We believe the basal boundary layer formed by thermomechanical substrate erosion during the passage of lava through the Cygnet lava pathway, and was decoupled from the overlying flowing lava as a result of its viscous-rheological behaviour. Removal and reformation of this layer during periodic fluctuations in the fluid dynamics of lava flow, was responsible for extensive erosion of the footwall dacite.

In addition, we attribute the presence of a ramifying network of plumose inclusions within the neighbouring Silver Swan massive sulfide orebody to the buoyant uprise through the molten sulfide pool during ore accumulation of a disrupted pre-existing hybrid layer at the base of the Silver Swan Pathway. These plumes exhibit recrystallised carapaces, unmelted cores, and compositions which range from pure dacite footwall to mixtures of footwall and up to 30% komatiite.

We propose that basal hybrid boundary layers are omnipresent components of actively eroding komatiite lava pathways.

Mantle source enrichment beneath Sardinia (Italy): evidence from oxygen isotope analyses

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Subduction-related volcanic suites in the Mediterranean area have radiogenic and stable isotopic characteristics that have been interpreted as the result of either addition of sediment and slab-derived fluids to the mantle or extensive crustal contamination. In order to distinguish between these two possibilities, we have investigated the Miocene subduction-related tholeiitic volcanic products of Monte Arcuentu in southern Sardinia. They resemble calc-alkaline lavas of the Aeolian and Aegean arcs in terms of K_2O-SiO_2 relations, and show mantle-normalised trace element patterns typical of subduction-related magmas. Their $^{87}Sr/^{86}Sr_i$ - εNdi values overlap those of the Roman Volcanic Province, the Aeolian Islands and the Aegean arc. Laser fluorination analyses of $\delta^{18}O$ values for separated phenocrysts are low (+6.17 to +7.46‰). Strong correlations of radiogenic isotopic ratios with SiO_2 and weak correlations with MgO are most easily explained by extensive (2-10%) mantle enrichment by subducted siliceous sediments. The correlation between SiO_2 and $^{87}Sr/^{86}Sr_i$ is very unusual within subduction-related magmatism, whereas that between $\delta^{18}O$ and $^{87}Sr/^{86}Sr_i$ shows that the Monte Artuentu suite forms an end-member composition for many subduction-related volcanic suites in the Mediterranean and elsewhere. The most basic end-member s show the least enrichment, and overlap the field of spinel peridotite mantle xenoliths from south-central Italy (Monte Vulture). These peridotites show unusual enrichment in $^{87}Sr/^{86}Sr$, similar to the subduction-metasomatised ultramafic massif of Finero in northern Italy (Alps).