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Origin of massive dunites of the crust-mantle transition in the Oman ophiolite at Wadi Zeeb (ICDP Oman Drilling Project)

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In the Oman ophiolite, several meters to more than 300 m thick zones of massive dunite constitute the 'crust-mantle transition zone' between lower crustal gabbros and mantle harzburgites. The origin of the massive dunites has been discussed controversially. They were interpreted to have formed by reactive melt infiltration (in analogy with processes that formed tabular dunites in the mantle harzburgites) or to represent early olivine cumulates, or both. The CM-1 and -2 drill cores of the ICDP Oman drilling project continuously sampled the crust-mantle transition at Wadi Zeeb (Wadi Tayin massif). The lowermost layered gabbros are underlain by 150 m of serpentinized massive dunite with thin layers and patches of olivine gabbro, troctolite and wehrlite, followed by serpentinized mantle harzburgites with dunite or gabbro dikes and pods. New data (including $^{187}Os/^{188}Os$ data and chalcophile element abundances) from CM-1 core samples show: (1) Harzburgite relics are nearly completely absent in the 150 m thick massive dunites. (2) In some massive dunites, a flow fabric appears to be preserved and is defined by streaks of spinel grains and serpentine-magnetite pseudomorphs after olivine. This foliation is about parallel to thin wehrlite and troctolite layers in the massive dunites. (3) Massive dunites are extremely depleted in Pd, Se and Re, indicating that the parent magmas were sulfide-undersaturated and melt extraction by compaction was efficient. (4) Ru/Ir and Os/Ir in some massive dunites are suprachondritic, whereas values in the overlying layered gabbro are subchondritic, an indication that layered gabbros are products of magmas that initially crystallized traces of laurite-ehrlichmannite in the dunites. (5) $^{187}Os/^{188}Os$ of massive dunites are suprachondritic, overlapping with data on layered gabbros, but both are systematically more radiogenic than mantle harzburgites. (4) and (5) indicate a close genetic relation between layered gabbros and massive dunites at Wadi Zeeb, which, together with (1) and (2) suggest a predominant origin of massive dunites as sills of olivine (± spinel) cumulates, indicative of Mg rich parent melt. A Mg-rich parent melt composition implies higher melt fractions induced by an enhanced slab-derived (?) water flux, which is consistent with suprachondritic $^{187}Os/^{188}Os$ in gabbros and massive dunites.