Geochemical and petrologic consequences of off-axis melt delivery: Evidence from the Oman ophiolite

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The Mansah diapir, located ~25 km from the fossilized spreading axis of the Oman ophiolite, offers a unique opportunity to study the petrologic consequences of off-axis melt delivery. Field mapping, combined with geochemical and Sr and Nd isotopic analyses of samples from the Moho Transition Zone (MTZ), reveals that the magmatic processes occurring in this setting differ greatly from those which take place during axial melting. The MTZ of the Mansah diapir crosscuts the foliation of the surrounding harzburgitic lithosphere. It is composed of massive pyroxenites and dunites and is devoid of plagioclase, and thus contrasts markedly with the MTZ of axial diapirs, which consist of gabbro and dunite. Though gabbro is absent within the Mansah diapir, gabbroic and microgabbroic amphibole-bearing sills and lenses intrude into the surrounding mantle and overlying crust. Such intrusions have not been reported from elsewhere in the Oman ophiolite. Clinopyroxenes from the Mansah MTZ pyroxenties have very low concentrations of incompatible trace elements, and show more marked LREE depletion than clinopyroxenes from gabbros of the axial MTZ. Surprisingly, the very depleted incompatible element signatures of the Mansah pyroxenites are coupled with relatively enriched Sr and Nd isotopic signatures (higher $^{87}Sr/^{86}Sr$ and lower $^{143}Nd/^{144}Nd$).

We will show that the exceptional features of the Mansah diapir can be explained by the preferential melting of pyroxenite veins in the underlying mantle. The derived melts are expected to have more enriched isotopic compositions than melts of peridotites. As the diapir rises, the pyroxenite melts interact with the depleted, hydrated off-axis lithosphere, forming clinopyroxene as a reaction product. Interaction with depleted harzburgite would have essentially no effect on the Sr and Nd isotopic compositions, but could explain the highly depleted incompatible trace element abundances.