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Oceanic core complexes and crustal accretion at slow-spreading ridges. Indications from IODP expeditions 304-305 and previous ocean drilling results.

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Oceanic core complexes expose intrusive crustal rocks on the seafloor via detachment faulting and are often associated with significant extents of serpentinized mantle peridotite at the seafloor. These serpentinite units have unknown thickness in most cases. Assuming that steep slopes surrounding the domal core provide a cross section, one would infer that they comprise much of the section for depths of at least several hundreds of meters. IODP expeditions 304-305 results at the Mid-Atlantic Ridge 30˚N (Atlantis Massif), taken together with previous ODP drilling results from the Atlantic and Indian Oceans, suggest that a revised model of oceanic core complex (OCC) development should be considered. All of the ODP/IODP drilling at 4 different core complexes and/or inside corner highs so far have recovered only gabbroic sections, with almost no serpentinized peridotite.

Here we explore aspects of a possible revised model for OCC development in which the « core » of these domes represents a period of greater than typical mafic intrusion in overall magma-poor regions of slow and ultra-slow spreading ridges. Exposure of the gabbroic intrusion(s) is enabled by deformation that localized predominantly within the serpentinized peridotite that initially surrounded them. The development of a detachment fault system on the central dome of Atlantis Massif may have occurred relatively late in its evolution, controlling the exposure along a domal high via mostly brittle faulting.

The proposed model is different from previous published models in that OCC represent the tectonic and morphologic expression of the magma-rich end-member of a fundamental mode of crustal accretion, the intrusion of gabbro plutons at depth, in an heterogeneous « plum pudding » type of crust. It does not necessarily imply that the detachment fault capping OCC is a single, deep-rooting fault. The geometry of the fault system may vary on a case-by-case basis, depending on the volume of gabbro present beneath the axis and on its crystallization depth. The model implies that serpentinized fault zones envelop the gabbro intrusions, thus explaining the paradox of dominantly gabbroic cores in the vicinity of seafloor serpentinites on top or on the flanks of OCC. Our model is consistent with recent seafloor observations and numerical modelling suggesting that OCCs do not represent the magma starved end-member of slow-spreading ocean ridges.