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Two breeds of ophiolite; their differing origins and contrasting plate tectonic significance, Archaean to Cenozoic

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Do ophiolites really tell us what goes on at MORs? Are they a reliable index of the location of a suture? A need to reassess these questions comes from two directions; subduction studies and the presence of un-re-equilibrated high pressure (17-60km), high temperature mineralogies in many ophiolite soles and tectonites.

The development of 'flat-slab' subduction interface profiles results from rapid basal subduction tectonic erosion (STE) of the upper plate, and has been the essential precursor to many collision nappe systems. STE thinning of oceanic-crusted forearcs enables imbricate forearc slices to be raised into view by accretion up-front. This is the cold-emplaced ophiolite (CEO) breed - it was never 'obducted'. Archaean greenstone belts are seen as CEOs too, the hot plate flatly subducted beneath them providing the heat and source material for the widespread intrusion of TTG granitoids.

STE implies that the subducting plate has thermal buoyancy. This has necessitated a redesign of the MOR process, so that hot, low-velocity-zone material, now recognized as stiff, is narrowly split beneath the axis and forms an integral part of subducting plates. The resulting MOR model is highly successful in its account of MOR features (including straightness, orthogonal segmentation, seismic anisotropy) but means abandoning the standard divergent mantle flow model, to which ophiolites have hitherto been compared.

However a special case of the new MOR model is found to offer an outstandingly fertile basis for explaining the many features of hot-emplaced ophiolites (HEOs) upon which most ophiolite studies have long been focused. In this HEO model a tectonic split forms in the floor of an old basin, creating a high-standing embryo MOR. *Lateral accretion to the mantle walls, if fast enough, builds up a deep column of still-partially-melted mantle whose accumulating buoyancy reaches the point (5-10km separation?) at which this ruptures its attachment to the original walls and* upwells catastrophically onto the basin floor sediments. The rapidity preserves the HP parageneses and the sediments provide the water for generation of SSZ (supra-subduction zone) magma sequences from the tectonite. Subsequent thermal tilting of the floor promotes uplift and further sliding. Plate convergence is not involved, so HEOs do not mark sutures but they do record additions to the basin system.

Keywords:- ophiolites; sutures; mid-ocean ridges; plate tectonics; Archaean greenstones.

Note, 2002: Italics entry has been substituted for “...which bursts its side. This unroofs the parental column of still partially melted mantle which...” Column buoyancy depends on predictable parameters, magma chamber roof strength does not.