Geophysical Research Abstracts, Vol. 6, 00596, 2004
SRef-ID: 1607-7962/gra/EGU04-A-00596

THE ROLE OF SILLS IN ACCRETION OF THE LOWER CRUST OF THE ANNIEOPSQUOTCH OPHIOLITE, NEWFOUNDLAND

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The Annieopsquotch ophiolite exposes a c. 5.5 km section of tholeiitic gabbros, sheeted dykes and basalts with moderate arc-signatures. The units are well exposed and laterally continuous, and, except for tilting to the sub-vertical, are little affected by emplacement- or post-emplacement related deformation. The along-strike consistency in thickness of the different components, and lack of major throw on spreading-related normal faults, suggests that the spreading center in which the Annieopsquotch ophiolite formed had a robust magma supply, consistent with formation at an intermediate to fast spreading ridge. The uppermost 500 m of the gabbro zone is dominated by massive diabasic textured to varytextured Fe-Ti-oxide gabbro, which has compositions similar to those of the abundant cross-cutting dykes. Beneath this 'roof-chill' is a 1.6 km thick zone constituted of sill-like intrusive units, each c. 10-30m thick, whose contacts are sub-parallel to the major stratigraphic units of the ophiolite. The local presence of crescumulates and comb structures, some indicating downward growth, and the common occurrence of fine-gained upper and lower margins imply cooling of intrusive units from both top and bottom. The orientation and planar character, as well as the 'chilled' margins and roof-crescumulates, are strong evidence that these bodies represent intra-plutonic sills. The sills consist of massive and layered gabbro and olivine gabbro cumulates, with only minor proportions of Fe-Ti-oxides. Inverse trace element modeling indicates that they crystallized from magmas identical to those occurring in the sheeted dykes and lavas. By matching the La/Yb ratios

of the model liquids to those of the lavas, we infer residual melt porosities in the sill-cumulates of 10-25%. In general, model liquids appear to become more evolved up-section, suggesting that most of the compositional evolution of the lavas and dykes was caused by fractional crystallization within the crustal sill complex. We suspect that the melt expelled by deep level sills generally migrated upwards to form new, more evolved sills; although in some cases, evolved melt remained trapped in deep-crustal intrusions. The compositional variability observed in the dykes and basalts could be interpreted to signify that pooling and homogenization of melts in a sub-axial magma chamber was inefficient. Our field and geochemical evidence, on the other hand, seems more compatible with a model whereby basaltic dykes and lavas were fed directly from the sills, suggesting that construction of the lower crust is dominated by the intrusion and partial crystallization of basaltic magmas within sills. The lowermost 500 m of the crust is dominated by massive to varytextured gabbro, olivine gabbro, Fe-Ti-oxide websterite, and layered troctolite-anorthosite. Field relationships suggest that the latter represent a fossil arc-related basement into which the tholeiitic sill complex was emplaced.