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Downhole evolution of mineral phases in drilled lavas and dikes from EPR crust (IODP Site 1256, Equatorial Pacific)

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The ODP / IODP three-leg campaign at Site 1256D (Leg 206, Expeditions 309 and 312) provides the first continuous in situ sampling of fast spread ocean crust from the extrusive lavas, through the sheeted dikes and down into the uppermost gabbros (Cocos plate; East Pacific Rise; eastern equatorial pacific). In order to study the downhole evolution of the minerals, we investigated the petrography of ∼100 samples from lavas and dikes. 27 samples were selected for electron microprobe analysis. Primary groundmass of the volcanic section consists mainly of plagioclase, clinopyroxene and Fe-Ti oxides, where anhedral clinopyroxene fills the interstices between the mostly euhedral plagioclase laths. Both clinopyroxene and plagioclase show strong chemical zoning, especially in the outermost rims. Many clinopyroxenes show a marked zoning which is in part developed as sector zoning. Some clinopyroxenes bear cores of relictic pigeonites, which show slightly higher Mg# (MgO/(MgO+FeO^{tot}), molar) than the host crystals. There is obviously no clear correlation between the chemical composition of the primary phases and the depth of the core.

The lowest ∼60 m of the dikes above the contact to the gabbros were recrystallized to “granoblastic dikes” by a metamorphic overprint which is characterized by the presence of two-pyroxene-bearing domains formed under granulite-facies conditions. Equilibrium temperatures estimated by the two-pyroxene thermometer range between 930˚C and 1050˚C, implying that conditions required for hydrous anatexis could be reached within the granoblastic zone, with the potential to generate partial melts of trondhjemitic composition. The evolution of the granoblastic overprint from top to

bottom is expressed by systematical changes of textures, phase compositions and calculated equilibrium temperatures, which are in concordance with a model of contact metamorphism, caused by a heat source below the sheeted dikes.

References

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