ABSTRACT

Four transects were drilled during Leg 163X on the continental shelf of Southeast Greenland. Transect EG68 (68° N) is located in crust that extends the volcanic stratigraphy of the flood basalt succession into the oceanic domain. Gentle seaward sloping basaltic basement was drilled on seven sites located on topographic heights just west of the consolidated marine sediment cover further seaward. Transect EG66 (66° N) is located immediately northeast of ODP Site 988 in seafloor representing the eroded featheredge and the landward continuation of the seaward dipping reflectors. Two sites were drilled at Transect EG66 both sampling the basaltic basement, one of which obtained normal polarized relatively young basalt. Transect EG65 (65° N) is located in the continental to oceanic transition of the seaward dipping reflectors and drilled volcanic basement at 40 sites. Sites located just seaward of this escarpment recovered friable sandstone overlain by volcanic flows that revealed systematic variation going upward in the stratigraphy. The lower series of Transect EG65 includes a distinctly suite of highly to moderately olivine and plagioclase phryic basalts. This series are overlain by aphyric to moderately phryic flows more typical for the margin. Transect EG64 (64° N) is located in the embayment south of Ammassalik in the featheredge of the seaward dipping reflectors. This transect was drilled at two sites, but was unable to confirm the previous prediction of a sedimentary basin. Transect EG63 (63° N) was drilled during ODP Legs 152 and 163 and was not visited during the present cruise. The finding from ODP Site 988 of relatively young lavas in crust assumed to be much older was reaffirmed. Flows drilled on Transects EG66 and EG68 give preliminary ages of 48-51 Ma that postdate the typical break-up ages of 56-53 Ma obtained from flows of the upper series on Transect EG65. The majority of flows drilled was reversely polarized and is assumed to be well within Chron C24r, known to predate the main seaward dipping sequence.

The flows are vesicular to massive, often with pipe vesicles and flow banding defined by alignment of plagioclase grains, flattening of vesicles, and weak color banding in the groundmass. They are fine-grained aphyric to seriated, highly plagioclase-clinopyroxene phryic basalts with olivine present in relatively low amounts. Plagioclase phenocrysts are present in all flow units as phenocrysts or glomerocrystic clusters. Landward of 36° 10' W, flows were moderately to highly olivine and plagioclase porphyritic. This latter suite of flows are referred to as the lower series, while the upper series are dominated by aphyric to highly plagioclase and clinopyroxene phryic flows with minor amounts of olivine. The lower series of Transect EG65 differs from the picritic flows drilled by ODP Site 917 by their additional content of plagioclase phenocrysts and are compositionally much more iron rich than the picritic flows of Site 917. The upper series of Transect EG65 are composed of typical plagioclase-augite-olivine phryic flows very similar to the tholeiitic volcanic basement sampled during ODP Leg 152 and 163 as well as from the onshore volcanic stratigraphy.

Unaltered olivine phenocrysts were only found in the Transect EG65 flows. The upper series contains Fo71 to Fo68 olivine phenocrysts, while the lower series contain Fo76 olivine phenocrysts; well below the Fo94 to Fo82 found in the picrites of ODP Site 917.
The pyroxene phenocrysts and microphenocrysts are augitic. The lower series of Transect EG63 contain pyroxenes with significant more magnesium content than the upper series. The lower series pyroxenes also have lower Ti/Al ratios than the pyroxenes from the other flows. This suggests that the Transect EG65 lower series flows were derived from parental melts significantly more primitive melts than the upper series flows. The plagioclase phenocrysts of the lower series of Transect EG65 are systematically more anorthitic (An$_{90}$-An$_{75}$) than the upper series plagioclase s (An$_{86}$-An$_{60}$) and phenocrysts from the other transects. There is a weak, but systematic, variation in phenocryst compositions northward along the shelf toward more primitive compositions as seen by increasing anorthosite component of plagioclase and iron content of augite phenocrysts.

All flows drilled during Leg 163X are basaltic, typically with olivine tholeiitic normative compositions. With the exception of the lower series at Transect EG65, all flows cluster with Mg/(Mg+Fe*) ratios below 0.57 and show a systematic increase in TiO$_2$, FeO, Na$_2$O, and K$_2$O with decreasing Mg/(Mg+Fe) ratio. This variation is typical for tholeiitic fractionation trends that are widely observed for the onshore plateau lavas. The petrographic and chemical information on the lower series of Transect EG65 (Mg/(Mg+Fe) ratios between 0.54 and 0.77) can in part be explained by plagioclase an/or olivine accumulation in modally variable proportions. The observed variation in the main group of tholeiitic flows can be accounted for by approximately 60-70 % fractional fractionation. The variation in the lower zone flows of Transect EG65 can be attributed to crystal accumulation from nearly 50 % olivine accumulation with relatively small amounts of plagioclase to about 30 % plagioclase and olivine accumulation in proportions between 60 to 45 % plagioclase and 40 to 55 % olivine.

The marked variability observed in the erupted lavas (phenocryst assemblages, phenocryst compositions, crystal fractionation and accumulation) suggests temporal and short-range lateral variation in magma chamber processes. Eruptions may have tapped multiple and perhaps zoned magma chambers. The flows characterized by crystal accumulation (olivine and plagioclase) may have originated from marginal zones of relatively primitive and deep-seated chambers. The more fractionated flows (olivine, plagioclase, and pyroxene) may have originated from more mature chambers higher in the crust. The tectonic development and structural buildup of the margin may have controlled the chamber and crustal depth being tapped. It is also possible that regional variation in mantle and source melting along the margin may be the cause of some of the observed variability in flow compositions (normative compositions). Future geochemical studies of the margin and its structural development may solve some of these questions.