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PETROLOGICAL DATA OF VOLCANIC MARKER BEDS OF THE MOUNT GALILI FORMATION, SOUTHERN AFAR DEPRESSION, ETHIOPIA

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The volcanics of the Galili excavation area [N 9° 44.101', E 40° 27.368'] are situated in the eastern rift shoulder of the northernmost active segment of the Main Ethiopian Rift (Fig.1). Seven main volcanic horizons occur in the stratigraphic succession of the Mount Galili Formation serving as characteristic marker beds with different lithologies: basalts, ignimbrites, pumice and lapilli tuffs. The geochemical investigations were mainly concentrated on the classification of the basaltic marker beds comprising main, trace and rare earth element analyses with the X-ray fluorescence and ICP-MS method at the Department of Geological Sciences, University of Vienna. In the Total Alkali Silica (TAS) diagram (fig.2), the basalts plot in between the picrobasaltic and basaltic field typical for a continental rift.

Volcanic fragments from a 4 meter thick ignimbrite layer on top of the Dhidinley Member vary, at high alkali levels (7-9 %), from trachytic to dacitic and rhyolitic composition, whereas at low alkali contents (< 7 %) they plot in the andesitic field. Concerning the chronostratigraphy of the Mount Galila Fm., the ignimbrite layer contains pumice clasts with sanidine phenocrystals useful for $^{40}Ar/^{39}Ar$ geochronology. This ignimbrite forms the most significant acid volcanic marker bed within the investigation area.

The basaltic lava flows that are from different stratigraphic positions have SiO_2 ranging between 43.7 - 46.3 wt-% and total alkalies between 2.6 - 3.5 wt-%. In the TAS diagram they plot in the fields of basanites and basalts. Trace element distributions (Zr/Y-Zr; Ti/100-Yx3-Zr) show typical "Within Plate" signatures with OIB affinities.

Mantle-normalized incompatible trace element patterns allow the division of the basalts into three groups: Group 1 is characterized by a strong positive Ba and a weak positve Nb anomaly; Group 2 shows, in addition to Ba and Nb, also a positive Sr anomaly; Group 3 is similar to Group 1 but is markedly less enriched in incompatible elements. In addition, the mantle-normalized REE patterns of Group 1 and 2 are relatively steep (LaN/YbN = 5-7), in contrast to Group 3, suggesting garnet in the residue.

Intitial $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios vary from 0.703713 to 0.704887 and from 0.512817 to 0.512899 respectively. Lavas with the most depleted radiogenic isotopes (MORB-like) correspond to Group 3 lavas, which show the lowest enrichment in incompatible elements. Furthermore, the isotopic ratios in combination with the high Ti/Yb and the low K/P ratios suggest rather heterogeneous magmatic sources and no crustal contamination. All basalts from these 3 groups show a positive Ba anomaly that is decoupled from the behaviour of the other incompatible elements, probably attributable to an ancient subducted slab.

Field observations, isotopic and geochemical data show that the youngest basaltic lavas have a MORB-like signature (Group 3) and the older lavas an OIB-like composition (Group 1, 2). This is consistent with the aulacogen nature of the East African Rift.

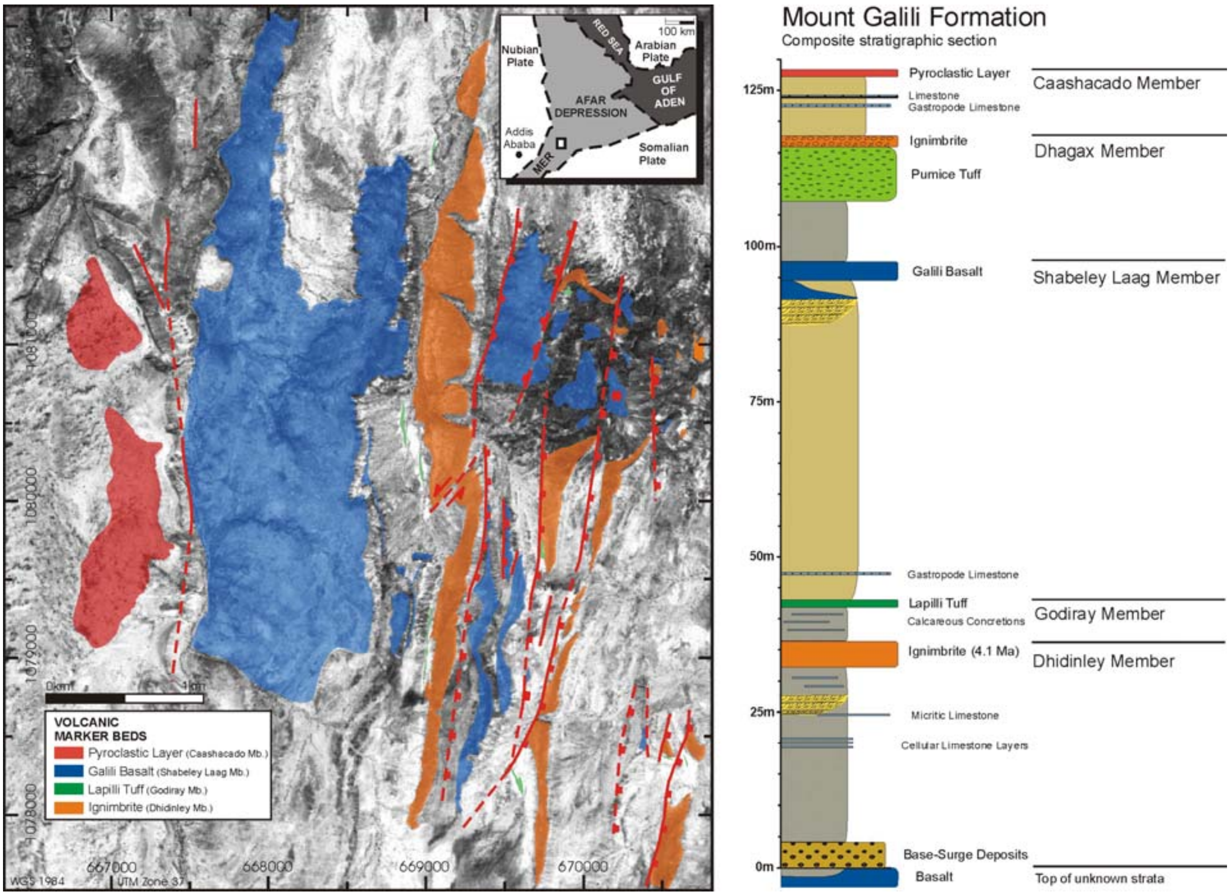

Fig.1: Main volcanic marker beds of the Mount Galili Formation.

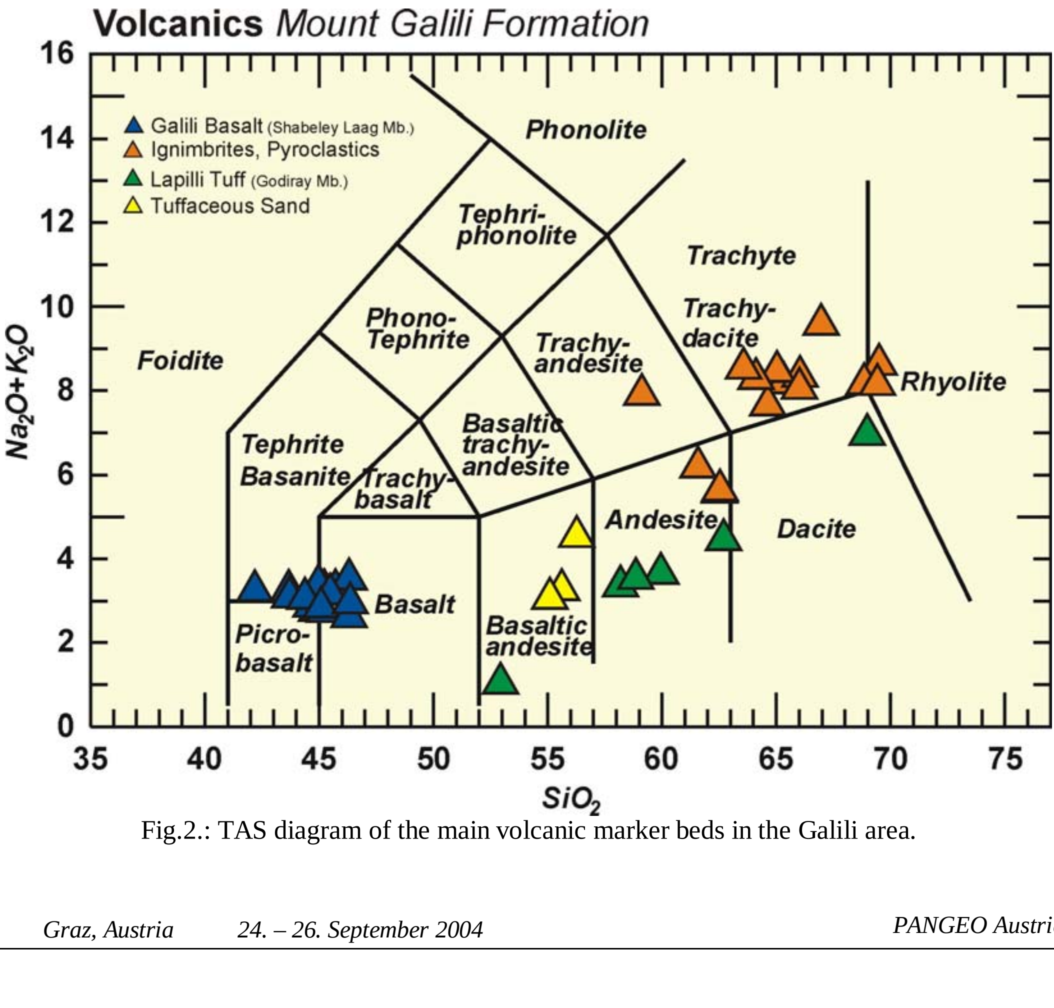

Fig.2.: TAS diagram of the main volcanic marker beds in the Galili area.