Petrogenetic study of high-Ti Ethiopian Flood Basalt Province: Case study from Maichew area

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Abstract

Six sequences of mafic and subordinate felsic volcanism are present in Maichew area; all mafic volcanics are of typical high Fe-Ti and defined as having > 10 wt. % FeO_t and > 2 wt.% TiO_2. The major and trace elemental data in the mafic lavas reveal six distinct sequential compositional types. The lower sequences 1, and 2 are alkaline strongly and variably enriched in incompatible trace elements than the upper sequences 3, 4, 5, and 6; their major and trace elements, which is lower in SiO_2 and Al_2O_3, and higher in incompatible elements like La, Ce, Zr, Nb, FeO_t, and TiO_2 than the upper sequences suggest an origin from deeper enriched heterogeneous source by small but variable degrees of melting. The other sequences also do vary in trace element and isotopic composition from each other.

The uncontaminated lavas of Sequence 1 show initial Sr- and Nd- isotopic (0.70342-0.70362, 0.51289-0.51283) ratios that differed from uncontaminated other sequences (0.7038-0.70402, 0.51296-0.51285). These and its characteristically different incompatible element contents suggest that it is may be an initial component of Afar plume during initial continental break. Moreover, heterogeneous crustal (lower and upper crust) signature is noted in all sequences.

At initial stage of continental break where temperature of melting is low, easily fusible plume component is sampled (sequence 1), whereas at later stage when degree of partial melting increased more depleted source involved and plume component is less evident. This interpretation requires robust geochemical and isotopic (Sr, Nd, Pb, and Hf) data constraints on whole-rocks and mineral separates from all six volcanic sequences, which is now under investigation. Furthermore, such systematic geological mapping and investigation should be carried out in different sector of the Ethiopian flood basalts.