Geochemistry and geobarometry of Eocene dykes intruding the Ladakh Batholith

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We present further distinguishing characteristics among Eocene dykes found along the Southern margin of the Ladakh batholith (NW-India). Coupled evidence from field structures and Nd-Sr isotope data showed that there are two broad dyke provinces extending over 50 km: between Leh and Tunglung, an "eastern", ENE-trending family with higher crustal assimilation; between Tunglung and Hemis Shugpachan, the "western" dykes trend NNW and have higher eps(Nd). The hornblende-bearing dykes of both families revealed crystallisation ages between 50 and 54 Ma, i.e. formed in the same tectonic setting at roughly the same time. In this study we present the geochemistry of these dykes and test hypotheses of common origin (i.e. formation from same magma chamber) through a novel statistical analysis.

The dykes show a large range in differentiation from basaltic to rhyolitic, but most are of an intermediate composition. High K_2O concentrations classify them as High-K calk-alkaline or shoshonitic. All dykes exhibit LREE enrichment and HREE depletion as well as negative Tb and Nb anomalies characteristic for subduction-related intrusives and extrusives. They are chemically similar to undated dykes E of Leh described by Ahmad et al. (1998), but show higher enrichment in incompatible elements and Pb in respect to Primitive mantle.

According to preliminary petrologic data, the emplacement pressure of the dykes appears to be lower in the west than in the east. A more comprehensive and extended study of a good number of selected samples will likely provide tighter thermobarometric constraints.

Although the dykes share many characteristics, they have not formed from the same batch of magma. Their REE patterns support a clear subdivision into chemically distinct groups. To test whether these groups formed from the same magma chamber, we used hierarchical clustering and multidimensional scaling. These tools are used to assess similarity/dissimilarity amongst individuals of a group - e.g. in evolutionary biology. Even though in hierarchical clustering we assume common origins, the analysis creates a hierarchy of groups by similarity. Multi-dimensional scaling allows for the natural grouping of samples with similar characteristics, without any assumption of origin. Therefore, these two methods are complementary. The results show the dykes are cogenetic, but clearly not consanguineous, i.e. have not formed from one, progressively differentiating magma chamber but from different batches of melt.

References

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