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Slab-steepening & breakoff: an alternative shallow-plate tectonic model for the genesis of plume-like melting anomalies in continental intraplate settings

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The classical plume model requires a set of prerequisite criteria to be fulfilled in order to be able to distinguish a region as a plume-related setting: a precursory domal uplift followed by the eruption of large volumes of volcanic material, the weakening of the magmatism in time in response to the disappearance of the plume head, the fixity of that particular area relative to other hot spots and the emplacement of hot and fertile asthenospheric mantle at shallow depths. The area including the Eastern Anatolian - Iranian High Plateau (EAIHP) and Lesser Caucasus (LC), located almost in the middle of the Alpine-Himalayan collision zone, accomplishes all of these criteria. Results of recent geological and geochemical studies revealed that the EAIHP & LC were subjected to a regional domal uplift around 12 Ma before the initiation of a widespread volcanism at around 11 Ma. This domal structure, which is comparable to that of the Ethiopian High Plateau (i.e. $\sim$1000 km in diameter with $\sim$2 km height) except for its north-south shortened asymmetrical shape, is currently being supported by the asthenosphere emplaced in exceptionally shallow depths ($\sim$40-50 km). The volcanic activity produced great volumes of volcanic material, covering almost half of the EAIHP & LC in a number of countries including Turkey, Russia, Georgia, Azerbaijan, Armenia and Iran. The aforementioned volcanism, although still active, weakened in time across the region.

By virtue of these features, the EAIHP & LC can be regarded as the site of a "melting anomaly" or "hotspot" resembling the setting proposed for mantle plumes. In spite of the presence of these parameters, recent geologic, geophysical and geochemical data

provide evidence against a plume origin across the EAIHP & LC. Results of these findings coupled with experimental studies support the view that both domal uplift and extensive magma generation can be linked to the mechanical removal of a portion or the whole thickness of the mantle lithosphere, accompanied by passive upwelling of normal-temperature asthenospheric mantle to a depth as shallow as 40-50 km. Mechanical removal of the mantle lithosphere might be controlled by delamination in the north (beneath the Erzurum-Kars Plateau in NE Turkey), while it was linked to slab-steepening and breakoff beneath a subduction-accretion complex in the south, in the north of the Bitlis-Pötürge-Zagros suture zone. Therefore, magma generation beneath the EAIHP may have been controlled by adiabatic decompression of the asthenosphere. The mantle source region possibly owed its exceptional fertility either to a subduction component inherited from a previous subduction event (i.e. Pontide subduction), to the oceanic crustal material previously subducted beneath the region, or to a combination of both. Delamination of lithospheric fragments might also have created a similar effect, by dewatering themselves as they sank and turning into fertile eclogite-rich ultrabasic blobs which are relatively fusible (i.e. the Eclogite Engine of D.L. Anderson). The EAIHP & LC example is important in showing that shallow plate tectonic processes (e.g. slab breakoff) have the potential to generate regional domal structures in the Earth's lithosphere as well as large volumes of magma in continental intraplate settings.