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Large provinces of silicic volcanism: intraplate vs subduction-related environments

Petr Tikhomirov[1*]

[1]M.V.Lomonosov Moscow State University

The large (over 10^5km^3) volcanic provinces dominated by silicic extrusive rocks are relatively rare in comparison with 'normal' mafic LIPs. According to the recently published overviews (Bryan et al., 2002; Bryan, Ernst, 2008), only four provinces of such a kind have been formed during the whole Phanerozoic: (1) Kennedy-Connors-Auburn (NE Australia), (2) Chon Aike (Patagonia and Antarctic Peninsula), (3) Whitsunday (Eastern Australia), and (4) Sierra Madre Occidental (Mexico). The revised classification of large igneous provinces (Bryan, Ernst, 2008) implies the silicic LIPs are a subgroup of LIPs, which fit the general criteria of a large igneous province. The intraplate tectonic setting (or intraplate geochemical affinity) is considered to be a mandatory attribute of all LIPs.
However, several volcanic belts of Central and Eastern Asia have the volumetric, temporal and compositional characteristics quite similar with those of the 'recognized' silicic LIPs. At least six such objects were formed during Phanerozoic: (1) Kazakhstan belt of Northern and Central Kazakhstan, (2) Balkhash-Ili belt of Southern and Central Kazakhstan, (3) Great Xing'an province of NE China, (4) SE China belt, (5) Okhotsk-Chukotka belt of the NE Russia, and (6) Eastern Sikhote-Alin' belt of SE Russia. These volcanic belts may differ from the typical silicic LIPs by slightly smaller portion of felsic rocks (40-90 vol.%, with the value of 75% stated as a lower limit for silicic LIPs), but there is no any definite gap inbetween. Taken together, all large provinces of silicic volcanism reveal common features, like the relatively young continental crust at the basement, the combined intraplate and subduction-related geochemical affinity, etc. Five of the six Asian volcanic belts mentioned above are considered to be continental arcs, and there are no strong evidences against their relation with subduction processes. In addition, all 'recognized' silicic LIPs were also formed not far (within 1000 km) from active subduction zones. Hence the statement, which completely denies the genetic link between LIPs and subduction, seems to need a correction.
Notably, the time gap between the formation of a large silicic volcanic province and a previous major magmatic event usually does not exceed 20 m.y., whereas for most of mafic LIPs such a magmatic pause is much longer, over 200 m.y. If large volumes of silicic magmas are being produced by crustal melting triggered by mafic underplating, the residual thermal energy retained in the crust may be an important factor, which promotes the melting. The correlation between the duration of a magmatic pause and the along-arc variations of average silica content in some volcanic belts supports this hypothesis. The lateral expansion of a mafic underplate may account for the spatial shift of silicic LIPs relative to the position of a typical continental arc. In principle, this model does not restrict the formation of silicic LIPs by the subduction-related settings: this may happen in any environment where the sufficient amount of basaltic magma is ponded at the base of a continental crust, which is thick and warm enough to melt. But the overview of Phanerozoic large provinces of silicic volcanism indicates such conditions usually take place near convergent plate margins.

References

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