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AMS-04 South American alkaline igneous complexes

Peralkaline syenites: polygenetic rocks?

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Peralkaline undersaturated syenites, a distinctive rock class, all share common chemical and mineralogical features, the more agpaitic varieties (lujavrites, khibinites, and related types) representing extreme cases. Peralkaline syenites occur mostly as isolated massifs, sometimes with extraordinary extensions (Khibina, Lovozero, Pilansberg, Poços de Caldas). Petrogenetic explanations have to take into account their chemical uniqueness, applying different petrogenetic processes than the ones that lead to the formation of the more common calc-alkaline rocks. What do we learn from petrography? Completely fresh syenits are rare, texture and mineralogy indicating high temperature deuteric and even milder hydrothermal activity and crystallization of late minerals. Chemically, these transformations point to extreme mobility of Ca, K and especially Na, as well as several trace elements (e.g., Sr, U, Th, etc.) and introduction of F, H and CO2 into the system. These features led some authors to consider these syenites as a special breed of rocks, their present chemistry removed from that of the original magmas (e.g., R.Mitchell, 2007, Geoch.Cosmoch.Acta, p.637; J.Schilling et al., 2007, GCA, p.889, both v.71, number 15S). The viewpoint goes as far as to consider some of them to be formed entirely by metasomatic processes. Therefore, varieties of syenites should exist, supposedly forming a clan of polygenetic rocks. What do we learn from natural occurrences? Mapping syenitic massifs clearly shows that they invaded as magmas, as attested by geometry of bodies, contact relationships, and structure (as shown in the cited examples). Naturally, equivalent volcanic-subvolcanic rocks are also known, again a clear framework for testing polygenetic interpretations. Poços de Caldas is a good example for testing polygenetic hypothesis. Here, "tinguaites" are dominant and crop out side by side with syenites (as well as with more differentiated lujavrites and khibinites). Chemical data (including RE and other trace elements) for both subvolcanic (usually very fresh rocks) and plutonic equivalents (always altered, LOI up to 5%, or more) are identical, the last rocks presenting plenty of recrystallized and low-temperature phases. Isotopic data for tinguaites and syenites (Rb-Sr,Sm-Nd,Pb-Pb systems) again do plot in diagrams in the same areas, indicating similar protoliths and petrogenetic evolution. There is not a single chemical-isotopic feature that can separate the PC tinguaites from the syenites. But geology and texture-structure clearly show that syenites were magmas and invaded as such. Here, alteration cannot be equated with "metasomatism": it did not generate new chemical types or different isotopic ratios. Literature data from other areas suggest similar conclusions as for PC, again indicating a magmatic origin for worldwide syenites, as can be shown, fundamentally, by evidence derived from geologic observations and mapping.

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