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Petrogenesis of Pliocene Alkaline Volcanic Rocks from Southeastern Styrian Basin, Austria

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Neogene volcanism in the Alpine Pannonian Transition Zone occurred in a complex geodynamic setting. It can be subdivided into a syn-extentional phase that comprises Middle Miocene dominantly potassic, intermediate to acidic volcanism and a post-extensional phase, which is characterized by eruption of alkaline basaltic magmas during the Pliocene to Quartenary in the Styrian Basin. These alkaline basaltic magmas occur as small eruptive centers dominating the geomorphology of the southeastern part of the Styrian Basin. The eruptive centers along the SE Styrian Basin from North to South are: Oberpullendorf, Pauliberg, Steinberg, Strandenerkogel, Waltrafelsen and Klöch. The suite collected volcanic rocks comprise alkali basalts, basanites and nephelinites.

Pauliberg: consists of alkali basalts that exhibit a narrow range of SiO2 (44.66-47.70 wt %) and wide range of MgO (8.52-13.19-wt %), are enriched in TiO2 (3.74-4.18 wt %). They are enriched in incompatible trace elements such as Zr (317-483 ppm), Nb (72.4-138 ppm) and Y (30.7-42 ppm). They have Nb/La ratio of 1.89 (average) and Cen/Ybn=15.22-23.11.

Oberpullendorf: it also consists of alkali basalts with higher SiO2 (50.39 wt %) and lower TiO2 (2.80 wt %) if compared with the Pauliberg suite. Incompatible trace elements are lower than in Pauliberg; Zr =217 ppm, Nb=49.8 ppm, Y=23.6 ppm and Nb/La=1.93. The Oberpullendorf alkalibasalts are relative to Pauliberg lavas more depleted in LREE (Cen/Ybn=12.78).

Steinberg: it consists of basanites with SiO2=44.49-46.85 wt %, MgO=6.30-9.13-wt %, and TiO2 =2.09-2.26 wt %. They are enriched in incompatible trace elements such as Zr (250-333 ppm), Nb (94-130 ppm), Y (24.7-31.9 ppm) and Nb/La=1.59 (average). The Cen/Ybn ratio varies between 18.17 and 22.83 indicating relative steep REE chondrite normalized patterns.

Strandenerkogel: it consists of nephelinites with narrow compositional ranges; SiO2 =40.99-42.44 wt %, MgO=6.63-6.92 wt % and TiO2=2.03-2.07 wt %. They are enriched in incompatible trace elements such as Zr (362-382 ppm), Nb (139-153 ppm) and Y (39.5-40.7 ppm). They have Nb/La ratio of 1.20 and are strongly enriched in LREE (Cen/Ybn=25.04-28.11).

Waltrafelsen: there are like in Strandenerkogel and have SiO2=42.42 wt %, MgO=6.55 wt %, and TiO2=2.01 wt %. The incompatible trace elements such as Zr (362 ppm), Nb (145 ppm) and Y (38.3 ppm) are similar to that of Stranerkogel. They have Nb/La ratio of 1.27 and are strongly enriched in LREE (Cen/Ybn=24.92).

Klöch: it consists of basanites with similar to Steinberg composition (SiO2=45.34-46.60 wt %, MgO=8.98-10.11 wt %, and TiO2= 2.28-2.37 wt %. Incompatible trace elements such as Zr (252-273 ppm), Nb (94.2-101 ppm) and Y (24.4-27.2 ppm) are high. They have Nb/La ratio of 1.71 (average). Their REE abundances compared

to Steinberg are slightly lower (Cen/Ybn=18.19-20.17).

The Nb/La ratio of all the studied rock varieties is greater than one indicates an OIB-like asthenospheric mantle source for the basaltic magma. All the studied rock varieties except alkali basalts of Pauliberg have Tbn/Ybn ratios which are comparable to those of the alkali basalts of Hawaii ((Tbn/Ybn range from 1.89 to 2.45); the Hawaiian basalts are considered to have been derived from a garnet–lherzolite mantle source (Frey et al. 1991; McKenzie & O'Nions, 1991). The chondrite normalized HREE abundances indicate the presence of garnet as a residual phase in the melt source region as can be inferred from the Dy/Yb ratio (average 2.93) which is greater than that of chondritic Dy/Yb ratio (1.57)

All the studied rock varieties display alkaline affinity and negative K-anomaly. The negative K-anomaly suggests either a source character, (e.g. frozen HIMU-like veins or pockets in the depleted lherzolite)? or it is consistent with the presence of a K-bearing hydrous phase in the residual mantle.

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