GEODYNAMICAL CONDITIONS AT THE NORTH OF KAMCHATKA SUBDUCTION ZONE: GEOCHEMICAL EVIDENCES

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The results of this report are based on two transects, which were carried out through Kamchatka peninsula during last decade: (1) SE-NW cross arc transect and (2) SW-NE Sredinny Range along arc transect. These data together with first Ar-Ar dating give us opportunity to study the distribution of the geochemical features of the volcanic rocks in space and time.

Cross arc transect (Churikova et al., 2001, 2007) from Gamchen volcano in Eastern Volcanic Front (EVF) through Central Kamchatka Depression (CKD) to Ichinsky volcano in Sredinny Range (SR) based on Quaternary rocks showed a continuous geochemical zonation from arc front to back arc, including strong and gradual increase in LILE, LREE and HFSE from the front to back arc of present subduction zone. These works demonstrated the existence of the general trend from fluid-dominated melting in the EVF, to upwelling of a strongly fluid-fluxed mantle below the CKD (Dorendorf et al. 2000) to melting of a fluid-enriched mantle aided by strong upwelling and decompression in the SR back arc region.

SR along arc transect (Volynets et al., this meeting) from Achtang lava field on the south to Tekletunup volcano in the north documented two age groups which are uniform in geochemical features from S to N. Late Miocene-Pliocene rocks (3.05-6.19 Ma) represents voluminous plateau lavas of highly depleted basalts with substantially low HFSE and HREE and high fluid-mobile elements values and in fact are similar to the typical arc front lavas. Late Pleistocene-Holocene rocks (less than 1 Ma) are monogenetic cones and stratovolcanoes that combine the subduction and within-plate-type signatures with enrichment in all incompatible elements. These rocks belong to back arc of the present subduction zone and partly were studied in above-mentioned cross-arc transect (Fig. 1).

As known from geological and geophysical studies (Legler 1977; Lander and Shapiro 2007; Avdeiko et al. 2007; Alexeiev et al. 2006) in Eocene-Miocene time SR represented the active volcanic front of the Proto-Kamchatka subduction zone. Later Kamchatka arc system has been modified by the step-by-step accretion from south to north of the Kronotsky terranes. The time of that accretion and the SE-ward 200 km shift of the subduction zone from the SR to the presently active EVF is estimated from 40 to 2 Ma. In the present structural setting, after the subduction front shifted to the SE, the SR represents the back arc region.

We argue that the systematic change in SR rock geochemistry is the result of this shifting which has been facilitated by a massive slab roll-back event. The SR plateau lavas represent the volcanic front until 3 Ma. The area to the W of the Miocene Sredinny arc front represented the back arc region at that time. Volcanic rocks of that region (mt. Khukhch: 3.78 Ma) are characterized by the absence of an arc signature; some even have true within-plate trace element patterns (Perepelov et al. 2006). The overlying Quaternary rocks are the present back arc lavas of the recent subduction zone. Both, the uniformity of geochemistry of young volcanic rocks along the SR and the systematic across arc geochemical zonation from contemporary arc front to back arc is explained by the only one mechanism - subduction of the Pacific Plate below Kamchatka.

The voluminous magmatism has continued to be active in the SR region up to the Holocene even though seismic data do not show a clear signal for a downgoing oceanic plate below this region. Geophysical researches show that the depth of seismicity decreases from south to north of Kamchatka. Kirby et al. (1996) show that the absence of the seismicity does not mean the absence of plate because at temperatures higher than 600-700°C seismicity is lost. Davaille and Lees (2004) argued that the seismicity of the subducted Pacific slab is gradually decreasing to the north as result of its heating.

Yogodzinski et al. (2001) argued that the edge of the Pacific Plate is traced below Shiveluch volcano while Portnyagin et al. (2005) show that slab edge traced through the Shisheisky complex. We argue, that the northern edge of the subducting Pacific Plate is marked by the termination of Holocene volcanoes and is represented by a wide (150 km) plate boundary as a set of transform faults. The absence of the young volcanism to the north of the on-land projection of the Alpha fault marks the plate boundary at depth (Fig. 1).

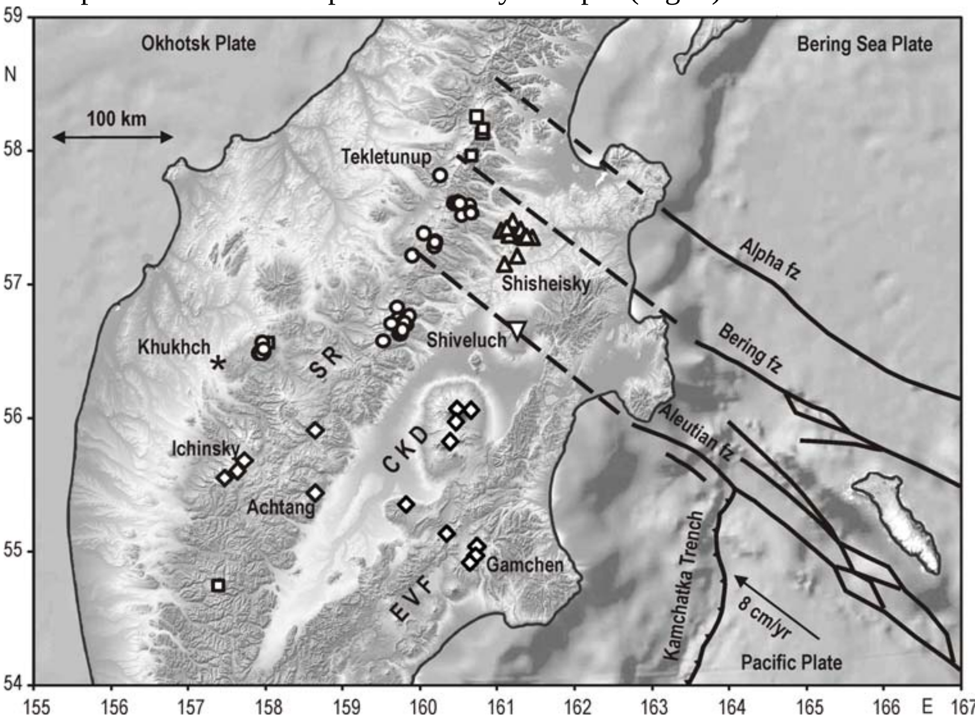

Fig. 1. Tectonic plan of the region, where three plates are joined on the base (Seliverstov, 1998). Relative motion of Pacific Plate and Bering Sea Plate produces the system of the transform fault zones: Aleutian, Bering and Alpha. Dashed lines show the extension of these transform zones under the Okhotsk Plate. Data sources for Late Pleistocene-Holocene volcanism: upturned triangle – Shiveluch (Yogodzinski et al, 2001), triangles – Shisheisky complex (Portnyagin et al., 2005), squares – data from Pevzner & Volynets (2006), rhombs – cross arc transect from Churikova et al. (2001), circles – SR long arc transect from Volynets et al. (this meeting), star – from Perepelov et al. (2006).

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