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Active fault study in the Kamchatsky Peninsula, Kamchatka-Aleutian junction: in search for collision

Andrey Kozhurin[1], Tatiana Pinegina[2]

[1] Geological Institute, RAS, Pyzhevsky per. 7, 119017 Moscow, Russia; email: kozhurin@ginras.ru
[2] IVS FEB RAS, Institute of Volcanology and Seismology FEB RAS, Piip Boulevard 9, 683006 Petropavlovsk-Kamchatsky, Russia; email: tsunami@kscnet.ru

The idea of collisional interaction between the Kamchatka and the Aleutian island arcs rests on current plate boundaries configuration and vectors of plate relative movements. The western Aleutians are thought to be driven northwest by transcurrent movement of the subducting Pacific plate and to collide with Kamchatka in the area of the Kamchatsky Peninsula. The portion of the Aleutians affected by frictional force is limited in the NW by the Kamchatsky Straight, south of which the transform fault (edge of the Pacific Plate) plunges beneath Kamchatka. The Kamchatsky Peninsula, in this setting, can experience just a push of the Komandorsky Islands block.

Geist and Scholl (1994) placed the collisional contact between the Komandorsky segment of the Aleutians and Kamchatka immediately east of the Kamchatsky Peninsula, at the foot of the underwater. First Gaedicke et al. (2000), then Freitag et al. (2001) and recently Baranov et al. (2010) interpreted some of active faults of the SW of the Peninsula to be onshore extensions of the western Aleutians longitudinal faults. Basically, this means 1) placing the collisional contact further west, within the SE of the Kamchatsky Peninsula, 2) combining the part of the Peninsula embraced by these active faults into one rigid block with the Komandorsky Islands block, and 3) denying any independent movements of the peninsula block. Kozhurin (2007), instead, left the contact in the bottom in the west of the Kamchatsky Straight, and based on a simple model of several longitudinal blocks of western Aleutians moving northwest with rates decreasing south let the peninsula block move freely, probably rotating clock-wise.

Among the active faults of the Peninsula, there are two major faults: major, in a sense, that they cut off the Kamchatsky Peninsula from the Kamchatka mainland thus making the Peninsula to be a real separate block. Both were shown earlier as inferred faults by Kozhurin (2007), and were later, in 2008-2010, studied (Fig. 1).

One of the faults stretches N-S along the foot of the Kumroch Range steeper east-facing slope (north of approximately 56.45°N). Plan-view sinuous geometry, trenching and GPR data brought together, clearly demonstrate thrust movements on the shallow west-dipping fault plane. The strike-slip component in this motion, most likely small, seems probable, but still no evidences for it have been found. The fault seems terminating at ~56.45°N, replaced there probably by the fault # 3 with opposite (NW) vergence. The second of the two major faults starts close to the northern termination of the thrust fault and striking WNW reaches the Bering Sea shoreline and then most likely extends eastward into the Pokaty Canyon. The dominating component of movements along this fault is right-lateral (5-6 m of one-event dextral offsets were observed in the field). Paleoseismic study of the fault revealed that lateral movements occur in a highly transpressional environment.

The two faults form a structural combination, which strongly suggests active northwestward motion of the Peninsula block and its thrusting under the Kumroch Range. Yet the exact direction of the advance of the Kamchatsky Peninsula block cannot be determined unless the ratio between the strike-slip and thrust or reverse components is known.

There are at least three faults inside the peninsula block that most likely continue underwater, some distance down the continental slope, probably down to its base. These are faults ## 4, 5 and 6 in the SE of the Peninsula. Presently, the only way to decide whether these faults are direct extensions of the western Aleutians longitudinal faults is to compare kinematics of the offshore and

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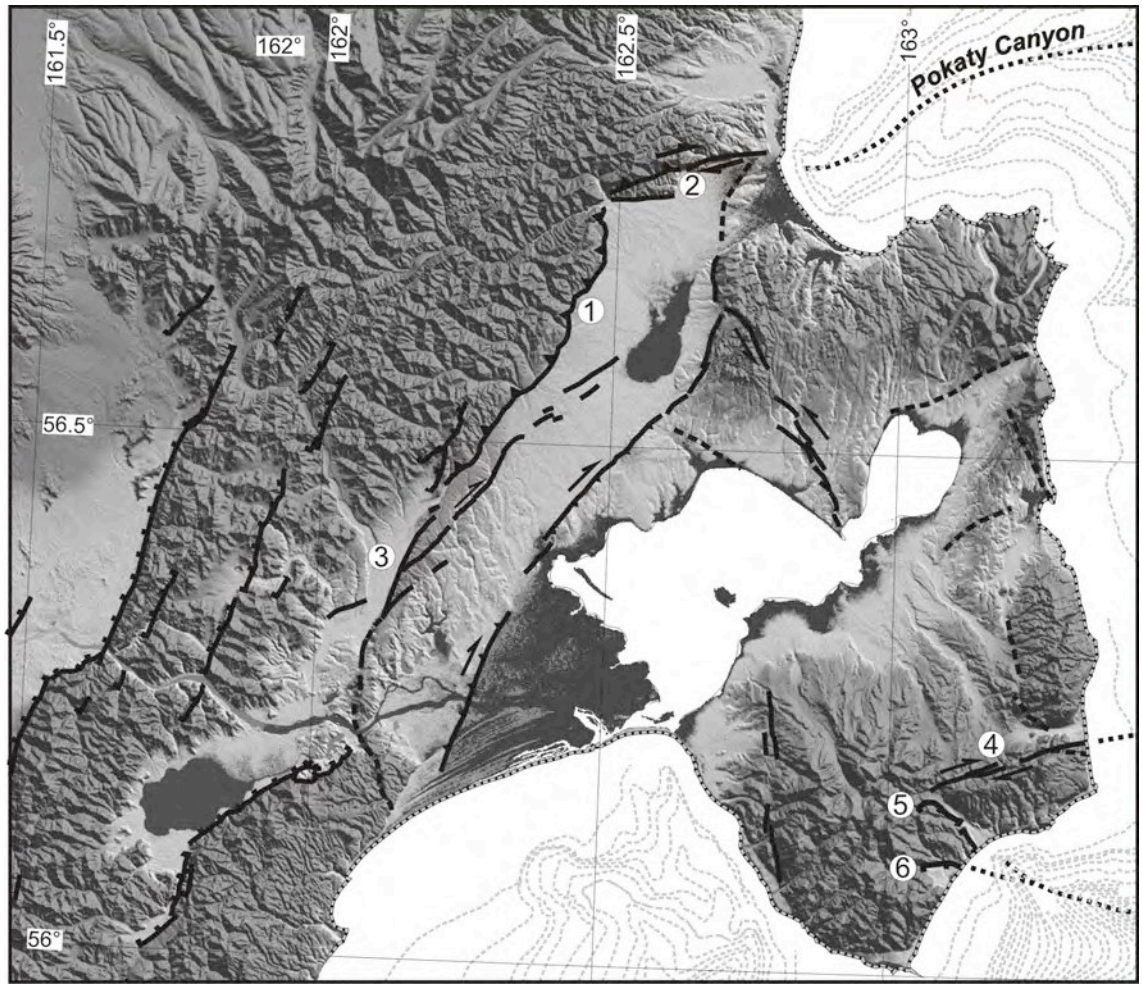

Fig. 1: Active faults in the Kamchatsky Peninsula, Kamchatka. Solid lines are for proved faults, dashed lines are for inferred faults. Arrows, ticks and teeth indicate strike-slip, normal and reverse/thrust components of movements. Dotted lines indicate probable position of underwater extensions of onshore faults. Numbers in circles are faults described in text.

onshore faults.

The fault # 4 is a purely strike-slip (right-lateral) fault. The vertical (reverse?) component of movements is negligibly small. The fault strike is notably oblique to the Bering Fault Zone of the Western Aleutians, and the absence of significant reverse or thrust component seems to contradict the model of direct onshore extension of the Bering Fault zone. Two other faults (5 and 6) of the NW strike display mostly normal motions and no signs of significant strike-slip offsets, neither left-lateral nor right-lateral, and thus cannot be linked easily to the underwater Pikezh Fault zone, which must be dominantly right-lateral. Thus it seems that the available data on the peninsula active faults kinematics do not much favor therefore the model, in which direct structural links between the Kamchatsky Peninsula block and the Komandorsky Islands block exist.

Based on the above, we conclude that active faulting in the Kamchatky Peninsula may be interpreted as reflecting collision of the western Aleutians with Kamchatka, but collision soft, when one of the colliding counterparts is not a single block but a set of several still able to move to some degree independently from each other.

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