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Trench-parallel elongation and shortening of fore-arc slivers related to passing triple junctions

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http://edugeo.miyazaki-u.ac.jp/earth/yamakita/namaketa.html

During the oblique subduction of an oceanic plate, the convergence vector can partly be partitioned into trench-parallel strike-slip faults that displace fore-arc slivers. The passage of a TTR- or TTF-type triple junction along a trench may cause a trench-parallel gradient of displacement in the fore-arc sliver, resulting in its elongation or shortening parallel to the trench. The TTR-type triple junction only causes elongation, whereas the TTF-type may also cause shortening. The passage of such triple junctions can explain the difference in widths of similar geologic belts along the eastern margin of Asia; e.g. between the Kurosegawa and South Kitakami belts, and between the Southern Chichibu and North Kitakami belts, which were all driven as fore-arc slivers in Early Cretaceous age.

Model: During the oblique subduction of an oceanic plate, the trench-parallel component of the convergence vector can partly be partitioned into strike-slip faults that displace fore-arc slivers. The passage of a TTR- or TTF-type triple junction along a trench may cause a trench-parallel gradient of displacement in the fore-arc sliver. Since the gradient of the displacement in the fore-arc sliver causes the change of its length, namely strain, the gradient may result in the trench-parallel elongation or shortening of the fore-arc sliver. We introduce a coordinate axis parallel to the trench and set v1 and v2 for the strike-slip velocities of the fore-arc sliver located at the positive and negative sides of the triple junction, respectively. In this case, the strain is represented by the ratio of v1 - v2 to the absolute value of vj, which is the velocity of the triple junction. The positive (v1 - v2) causes elongation and the negative (v1 - v2) causes the shortening of the fore-arc sliver, respectively. If we assume no volume change, the elongation and shortening of the fore-arc sliver lead to its thinning and thickening, respectively.

In the case of the TTR-type triple junction, where v1 is always larger than v2, the trench-parallel elongation of the fore-arc sliver can only take place. The TTF-type, on the other hand, may cause both elongation and shortening. The absolute value of vj is in inverse proportion to the amount of strain. In particular, when a fore-arc sliver goes ahead of a TTR-type triple junction at a faster speed, the delayed triple junction may split off a new fore-arc sliver from the upper plate; namely, tectonic erosion may occur.

A plate boundary between two oceanic plates is usually a combination of ridges and transform faults and has a zigzag shape. Subduction of such a plate boundary causes coexistence of the elongation and shortening of a fore-arc sliver along a single trench.

Possible example: Such boundaries of oceanic plates likely passed along the eastern margin of Asia in Mesozoic age, and the deformation related to the passages may be recorded in the pre-Tertiary rocks of the Japanese Islands.

Two pairs of geologic units with similar constituents and structural positions are recognized in the Outer Zone of Southwest Japan and the Kitakami Mountains of Northeast Japan. One pair is the Kurosegawa and South Kitakami belts, commonly containing pre-Silurian basement and Silurian to Cretaceous shallow-marine strata. Another pair is the Southern Chichibu and North Kitakami belts, which comprise similar Jurassic accretionary complex and lie along the outer side of the Kurosegawa and South Kitakami belts, respectively. Each pair of belts is considered to have the same origin, but the South and North Kitakami belts are much wider than the Kurosegawa and Southern Chichibu belts. Early Cretaceous sinistral strike-slip movement likely displaced all of the belts as fore-arc slivers. Paleobiogeographic data and shear fabrics suggest sinistral strike-slip movements along the Kurosegawa Belt, and its constituent rocks are discontinuously distributed as lens-like bodies parallel to the length of the belt. On the other hand, the displacement of each sinistral strike-slip fault and shear zone recognized in the South Kitakami Belt is relatively small and is easily reconstructed with some offset markers. The reconstruction shows that these faults and shear zones form a strike-slip antiformal stack, indicating the shortening of the belt in NS direction. Thus our foregoing model suggests the Early Cretaceous passage of a TTR- and TTF-type triple junctions along Southwest Japan and the Kitakami Mountains, respectively.