Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)
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SIT07-08 Room:A03 Time:May 25 11:30-11:45

Accretion vs. tectonic erosion in Cenozoic margin of southwest Japan

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Accretionary and erosive margins provide tectonic end-members within our understanding of the subduction zone setting, and how these tectonic processes might be recorded and recognizable in ancient subduction complexes remains a challenging issue. Tectonic erosion includes sediment subduction and basal erosion along the plate boundary megathrust which drags down the crust of the upper plate into the mantle. This process means that the ”evidence” for such erosion is commonly based on lost geological tectono-stratigraphic data, i.e. gaps in the record, and must be speculated from indirect phenomena such as subsidence of the forearc slopes. A topographically rough surface to the subducting oceanic plate, such as that provided by seamounts, has been suggested to work like an erosive saw carving into the upper plate. Another mechanism of basal erosion has been suggested to be hydrofracturing of upper plate materials due to dehydration-induced fluid pressures, resulting in entrainment of upper plate materials into the basal decollement. Considering the interaction between the ˜30 km thick crust of the upper plate and subducting oceanic plate, a subduction dip angle of ˜15 ^{o} , and convergent rate of ˜10 cm/year, at least ˜1 Ma of continuous basal erosion is necessary to induce clear subsidence of the forearc because the width of plate interface between the upper crustal and subducting plates is about 115 km (30/cos15 ^{o}). In several examples of subduction zones, for example the Japan Trench and the Middle America Trench off Costa Rica, the subsidence of a few thousand metres of the forearc, combined with a lack of accretionary prism over a period of several million years, suggest that the erosive condition needs to be maintained for several to tens of million years (e.g. von Huene & Lallemand 1990) .

Such an age gap in the ancient accretionary complex would be one of the signals for tectonic erosion in the past. Recently, a hypothesis that a tremendous amount of tectonic erosion has taken place during Early Cretaceous and middle to late Miocene time has proposed based on age gaps in the accretionary complex. Such age gaps in the accretionary complex, however, do not automatically imply that tectonic erosion has taken place, as other interpretations such as no accretion, cessation of subduction, and/or later tectonic modification, are also possible. In the case of the middle to late Miocene period, for example, a drastic tectonic change after the opening of the Japan Sea and clockwise rotation of southwest Japan may be linked to ridge subduction or a switch in subduction from the Pacific to Philippine Sea Plate. Recent drilling in the forearc of the Nankai Trough suggests that the accretion was renewed at ˜6 Ma after igneous activity intruding the early Miocene accretionary prism. Kimura et al. (2014) interpreted that the subduction ceased between ˜12 Ma to ˜8 Ma due to the transference of subduction from the Pacific Plate to the Philippine Sea Plate, as opposed to the ”continuous subduction with subduction erosion” viewpoint. These different scenarios need to be tested in the future.

References

von Huene, R. & Lallemand, S. 1990. Tectonic erosion along the Japan and Peru convergent margins. Geological Society of America Bulletin, 102, 704-720.

Kimura, G., Hashimoto,Y., Kitamura,Y., Yamaguchi,A. & Koge, S. 2014. Middle Miocene swift migration of the TTT triple junction and rapid crustal growth in southwest Japan ? A review, Tectonics 33, 1219?1238, doi:10.1002/2014TC003531.