[EJ] Evening Poster | S (Solid Earth Sciences) | S-CG Complex & General

[S-CG59]Structure and evolution of Japanese islands - Formation of island arc systems and earthquake cycles

convener:Hiroshi Sato(Earthquake Prediction Research Center, Earthquake Research Institute, The University of Tokyo), Masanao Shinohara(Earthquake Research Institute, University of Tokyo), Masahiro Ishikawa(横浜国立大学大学院環境情報研究院, 共同), Makoto MATSUBARA(National Research Institute for Earth Science and Disaster Resilience)

Tue. May 22, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

Subduction processes such as accretion, back-arc-spreading, and arc-arc collisions have shaped the Japanese island arc. Recent advances in seismic imaging, both passive and controlled source, have produced new images of the crust-mantle structure under Japan and surrounding regions. Through the influence of pre-existing faults and rheological structures, these crust and mantle structures are exerting strong control on active tectonic processes like seismic activity and crustal deformation in the overriding plate. We seek contributions that document and/or model the deformation of the Japanese islands over a variety of time scales from the earthquake cycle to the tectonic evolution of the Japanese island arc, and from a range of research fields including seismology, geology, geochemistry, tectonic geomorphology, and geodynamics. Multidisciplinary studies are encouraged. We also welcome contributions in numerical or analogue geodynamical modeling that explore deformation processes.

[SCG59-P07]**Subsidence in an inverted failed rift basin, Niigata Basin, northern Honshu, Japan**

*Tijn Jelle Nederstigt[1,2], Johan S. Claringbould[1], Hiroshi Sato[1], Anne van Horne[1,3], Liviu Matenco[2]
(1.Earthquake Research Institute, University of Tokyo, 2.Faculty of Geosciences, Utrecht University, The Netherlands, 3.Department of Geology and Geophysics, University of Wyoming, Laramie, WY, USA)

Keywords:local isostasy, inversion tectonics, crustal properties, Niigata Basin, backstripping, subsidence analysis

The Sea of Japan continent-ocean back-arc system is characterized by an Early to Middle Miocene rifting event that extended the Sea of Japan lithosphere in two different styles: an event of continental drift opened up the Japan, Yamato, and Tsushima basins, and failed rifting occurred in the continental crust along the west coast of northeastern Honshu producing the Niigata and Akita basins. These failed rift basins are characterized by high Vp anomalies in their lower crust that are interpreted as mafic blocks [Sato et al., 2012], suggesting a rheologically strong zone. After a Pliocene tectonic inversion of the back-arc system, the failed rift basins experienced greater amounts of shortening than the hot, and presumably weaker, volcanic front [Sato, 1989]. Based on sediment accumulation rates [e.g. Takano, 2002], accelerated subsidence is observed in parts of the Niigata basin, as it is exposed to a highly compressional stress regime.

In this study, we aim to examine the reason for this subsidence by calculating the total subsidence of the basin over time, and the subsidence of the Niigata basin due to sediment and water loading alone using 1D Airy backstripping. The difference between these calculations represents the contribution of thermo-tectonic effects on the vertical movements of the basin. Wireline logs, rocks samples, and biostratigraphic data from oil corporation records for eleven wells drilled in the Niigata Basin between 1960 and 2000 are used to derive the parameters needed for the model: paleobathymetry, age-depth relations, and exponential porosity-depth relations for different lithologies.

The results show rapid tectonic subsidence of 1200 – 2000 m between approximately 17 – 15 Ma that is interpreted as large scale syn-rift crustal thinning. Between 15 – 3.5 Ma, the tectonic subsidence exponentially decreases totaling at approximately 1000 m of subsidence. We attribute this stage to the post-rift thermal relaxation of the crust. At 3.5 Ma in several wells, accelerating subsidence of up to 3500 m is observed, due to both tectonic and sediment loading processes. At approximately 1 Ma, differential behavior between the northern and southern clusters of wells is observed. The southern wells show gradual uplift in both the tectonic and total subsidence curves, in accordance with the prevailing compressional stress regime [Sato, 1994]. In the northern wells, gradual tectonic uplift is observed, whereas we observed a net downwards vertical motion due to sediment loading alone.

The results indicate that at the time of inversion, a densification of the crustal column in the Niigata Basin took place. Possibly the mafic block as described by [Sato et al., 2012] in the basin’s lower crust experienced high pressure phase transitions, dynamic recrystallization or internal faulting. When the subsidence curves stabilize around 1 Ma the crustal column of the Niigata Basin becomes less dense, possibly due to two granitic crustal thrust wedges as described by [Sato et al., 2012] that close in on the basin from the eastern and western sides along outwards dipping reverse faults. We used a back-of-the-envelope analytical model, to calculate the isostatic response of the crust to the onset of such a thrust wedge. We found that this process contributes to the isostatic uplift that is observed in most wells at 1 Ma. We attribute the ongoing total subsidence that still occurs in the northern Niigata Basin to crustal loading due to rapid sedimentary infill of the area’s depressions.

This study demonstrates the importance of prevalent crustal properties in determining the subsidence behavior of an inverted failed rift basin. More research needs be done on the on the flexural rigidity of the crust beneath the Niigata Basin in order to further constrain the isostatic response of the basin to loading. This information can then be used to validate the assumptions of local isostasy that were made in this study.