Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

HQR24-P04 Room:Poster Time:May 1 18:15-19:30

Reconstruction of tectonic movements using ravinement surfaces: A case study for the subsurface geology of the Osaka

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Ravinement surfaces are produced when the sea floor is eroded into a flat surface by the action of waves or tides during a marine transgression. They are preserved in the transgressive deposits as a sharp erosion surface. In a geological cross section across the ancient shoreline, primary ravinement surfaces appear as a subhorizontal line slightly dipping toward the sea. In a cross section, comparing successive ravinement surfaces deformed by tectonic movement allows for the reconstruction of relative tectonic movement. For example, when successive ravinement surfaces are parallel, the entire region has subsided or uplifted uniformly. However, when the lower ravinement surface dips more steeply than the upper ravinement surface, this indicates differential subsidence. With sufficient data, ravinement surfaces can be used to reconstruct the deformation history of an area in three dimensions. Furthermore, because many ravinement surfaces in Quaternary sediments are associated with transgressions related to glacio-eustatic sea level changes, the age of the surfaces can determined and used to estimate the rate of the tectonism.We used the reconstruction of tectonic movement derived from ravinement surfaces to reconstruct the shallow subsurface geologic structures of the Osaka Plain, an intra-arc basin in the Japan island arc. For this study, we constructed cross sections from drill hole data extracted from a civil engineering drilling database. Our study revealed that, in different areas of the Osaka Plain, the land had been uplifted and differentially subsided toward the sea; a relatively large uplift occurred near a flexure zone, and the rate of the tilting of an anticline was constant.

Keywords: ravinement surface, tectonic movement, intra-arc basin, Quaternary, drilling database