

Simultaneous Eruptions and Earthquakes in the 9<sup>th</sup> Century, in the East and Central Japan\*Masashi TSUKUI<sup>1</sup>

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Based on geological and archaeological data as well as historic documents, Tsukui et al., 2007 (Japan Geoscience Union 2007 Meeting, abstract), Tsukui et al., 2008 (Bull. Volcanol. Soc. Jpn) reviewed eruptions and earthquakes which have occurred during the 9th century in the East and Central Japan. The results reconfirm vigorous activities at Fuji volcano (800 AD, 838-864 AD, 864 AD), Izu-Oshima (-838 AD < N3, N2, N1 < 886 AD), Niijima (-857 AD and 886 AD), Kozushima (838 AD), and Miyakejima (832 AD? and 850 AD). Beside these eruptive events, a big eruption at Niigata Yakeyama volcano occurred in or around 887 AD. Chokai volcano also erupted in 871 AD, and 810-823 AD. In addition, earthquakes with a magnitude from 7 to 8 took place at Itoigawa-Shizuoka Tectonic Line active fault system (ISTL; in 841 or 762 AD), and at Nagano fault system (887 AD). Along the Eastern Margin of Japan Sea, earthquakes hit Akita plains (830 AD), Shonai plains (850 AD) and Echigo plains (863 AD). Plate-boundary great earthquakes occurred at Off Tohoku (869 AD Jogan Earthquake) and at the Nankai trough (887 AD Ninna earthquake). A linkage of these big eruptions and seismic activities in the 9th century extended over 800km long crossing Japan Arc. Geologically this seems to be a surface expression of East-West compression along eastern margin of the Amurian Plate which was driven by the eastward motion of the plate (2cm/yr to East Japan; Ishibashi, 1995, Chishitsu News).

Along the eastern margin of Japan Sea, the Amurian plate subducts beneath the East Japan (Okhotsk plate or North-American Plate). At the northern part of the ISTL, the East Japan thrust over Amurian plate. Along the Nankai trough, the Philippine Sea plate subducts beneath the Amurian plate. The central part of the ISTL acts as left-lateral fault to switch the direction of subduction system.

Judging from the relation between volcanic activities and 869AD Off Tohoku Jogan earthquake, 887AD Nankai trough Ninna earthquake, volcanoes did not necessarily activated by the earthquakes, but often erupt prior to great earthquakes. These examples show that it is difficult apply a simple model to the 9th century episodes that an earthquake release compressional stress and allow magma ascend.

During the recent 60 years, eruptions (Miyakejima (1962 AD, 1983AD, 2000AD), Izu-Oshima (1986 AD), Submarine eruption off Ito (1989 AD)), earthquakes along the Eastern Margin of Japan Sea (1964, 1983, 1993, 2004, 2007 AD), the Great East Japan Earthquake off Tohoku (March 11, 2011, M9.0), North Nagano earthquake (March 12, 2011 M6.7; extension of Nagano Fault System), and Kamishiro Fault Earthquake (2014AD, M6.7; occupying northern part of ISTL Active Fault System) are taking place in areas overlapping with those occurred in the 9th century.

Overflow of magma from the Miyakejima summit crater, dome formation of Niijima and Kozushima of the 9th century imply high magma head or high horizontal stress in Izu Islands. Whereas lateral eruption at Izu-Oshima in 1986 AD and the collapse of summit at Miyakejima in 2000 AD resulted from intrusions of a large amount of magma into neighboring crust indicate lower horizontal stress in recent years. Although many common points are found between 9th century and the present, the stress states are different and it is difficult to find a rule in the order among outbreak of earthquakes and eruptions.

Keywords: 9th century , linkage of eruption and earthquake, east-west compression

