Active monitoring of Asperities-Reflectors System:Time lapse monitoring of subducting interplate earthquakes and magma reservoir

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Interplate earthquake activity strongly depends on physical coupling state at subduting plate boundaries, which can be classified as asperity and non-asperity. The strong PP wide-angle reflections from the subducting plate boundary were found in the aseismic subduction zones in the Japan Trench and in the slow slip region in the Nankai Trough. Those suggest the presence of low-Vp/soft materials and/or fluid at the subducting plate boundary. Such regions may cause slow-slip continuously or intermittently. In the volcanic region, magatisms is related to magma mobility and volcanism. Magma reservoirs have been identified by PxP, SxS,PxS, and/or SxP phases, and continuous monitoring of such reflected phases can inform us dynamic behavior of magma reservoirs.

If we can map the areas of strong PP reflections by observations, we will be able to map the distribution of asperities along the plate boundary and/or magma reservoir, and we can actively monitor the physico-chemical state change of them. In order to actively monitor the physical and chemical state at the plate boundaries and of magma reservoirs, it is necessary to integrate mapping, active geophysical monitoring, continuous observation and petro-physical studies. We call such integrated studies as EARS (Exploration of Asperities and reflection System).

The mapping and monitoring of the reflections at subducting plate boundaries and magma reservoir can be done by 2D, the 3D seismic reflection surveys, wide-angle reflection-refraction surveys and time-lapse measurements. To realize continuous monitoring of the seismic reflection intensity, we can use the ACROSS (Accurately-Controlled Routinely-Operated Signal System), which is an integrated active seismic monitoring system composed of a system synchronized by the GPS clock, and can repeatedly transmit frequency modulated seismic waves combined with sophisticated algorithm for signal analysis.

In order to find best locations of active source and receiver's pair in real field situation, we analyzed natural earthquakes, which have distinguished phase in central Japan. Those phases are interpreted as reflections from plate boundary. Examination of control source experiment in the central Japan also suggests strong reflected phase beneath Ontake volcano or Atera fault.

We conducted some FDM seismic simulation using assumed ACROSS source for the fluid saturated plate boundary and magma reservoir beneath volcanoes. In synthetics seismogram calculation, strong SS and PS refection phases appear at foot of volcano when a 6 km width of lens shape magma body is situated at 8 km deep.