Japan Geoscience Union Meeting 2015
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MIS35-P01 Room:Convention Hall Time:May 24 18:15-19:30

A resistivity model of the back arc region in the NE Japan arc based on marine and island MT data

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Distribution of physical properties in the back-arc in NE Japan subduction zone have not been understood because the area is mostly located beneath the sea floor. In this study, we estimated electrical resistivity distribution in this area based on electromagnetic data obtained on the seafloor and islands in the eastern part of Japan Sea. The ocean bottom EM data were obtained with 6 ocean bottom electro-magnetometers (OBEMs) between April and August 2013 by MR13-02A and NT13-18 JAMSTEC scientific cruises. The island data were acquired in the 3 islands in the Japan Sea (Tobishima, Awashima and Sado islands) between April and October 2013. These recorded time-series data were converted to a frequency-domain impedance tensor based on the BIRRP program (Chave and Thomson, 2004). As results, high-quality MT responses and geomagnetic tippers in both the trench and back-arc areas. The phase tensor ellipses (Caldwell et al. 2004) indicates high Φ_{max} (>65 degrees) and Φ_{min} (>50 degrees) in the long periods (>8000 seconds) implying conductive zone in the deep area. The ellipses in the short period show strong contrast between western part (Yamato basin) and eastern part of study area, which indicate heterogeneity in crustal structure. Then we also inverted the MT impedances into resistivity distribution based on the 3-D inversion code (Tada et al., 2012) after the correction local topographic effect. The inversion result shows a significant conductor above the subducting Pacific plate. A surface conductor is also estimated beneath the Yamato Basin. These features are consistent to the phase tensors discussed above. The deep conductor may be related to dehydration in subducting Pacific Plate and convention in the mantle wedge. The surface conductor may reflect sediments rocks formed during back-arc opening in Miocene.

Keywords: NE Japan arc, Japan Sea, Back arc, magnetotelurics, resisitivity, Geofluid

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Water content of small body surfaces: Effects of mutual collisions

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Small bodies in the Solar System transported water from outer region beyond the snowline to the Earth and other terrestrial planets. These small bodies experienced mutual collisions since their formation through their evolution. Consequently, craters were formed on the surfaces, rubble-pile bodies, i.e., once collisionally disrupted and re-accumulated bodies, such as asteroid Itokawa were formed, and asteroid families, groups of asteroids with similar orbital elements, were created.

In order to understand the evolution of small bodies from the early Solar System to the present, with focusing on the role of small bodies as the transporter of water, the present orbital and size distributions of dry and wet small bodies are ones of key clues. The presence of hydrated minerals and water ices are detected by visible and infrared spectra observations.

In this presentation, we discuss on the relationship between water content of small body surfaces and their mutual collisions. Even if hydrated minerals or water ices were lost from the surfaces due to some processes, the interior of the bodies may be still wet. Impact-induced dehydration is one of possible processes that release water from the surface. On the contrary, erosive collision may expose fresh wet materials from the interior. On the other hand, collision brings wet materials on the surfaces of dry small bodies.

Impact-induced dehydration rate has been studied by analysis of shock-recovered hydrated minerals or detection of impact-induced water vapor (e.g., Sekine et al., 2015). The dehydration ratio is dependent on not only peak shock pressure but also the initial porosity. Meteorite texture was found to be comminuted due to vapor released from hydrated minerals in porous carbonaceous chondrite materials in shock recovery experiments, and fine fragments were expected to be explosively dispersed from hydrated, porous asteroids (Tomeoka et al., 2003). We prepared dunite and serpentinite blocks as dry and wet targets and gypsum and hemihydrate blocks as porous samples for impact experiments. Projectiles accelerated to the velocity of about 5 km/s, which is the average collision velocity in the asteroid belt, were impacted to the targets. No clear difference was observed in the ejecta patterns, i.e., fragment velocity fields, for non-porous dunite and serpentinite targets. The similar cone-shaped ejecta were observed for the hemihydrate targets, while hemispherical vapor clouds were observed from gypsum targets. How the dehydration, comminution and ejection of fragments depend on impact angle and porosity and water content of targets have not been fully addressed.

On the other hand, impact-delivery of exogenic materials on the surface of small bodies was visualized by the discovery of carbonaceous materials on the surface of asteroid Vesta by Dawn space mission. We performed impact experiments of projectiles of rocks, meteorites and porous ceramic projectiles into targets of various materials in order to investigate the degree of disruption of projectiles and penetration depth of projectiles into the targets. We found that fragments of rock projectiles are mixed and consolidated with simulated regolith particles. We also showed that impactors with large porosity can survive with larger fraction owing to local microscopic collapse of pores that inhibits growth of overall fracture of the impactors and thus can penetrate deeper into targets. We will discuss on the effect of volatile materials in impactors based on the results of impact experiments conducted using plastic projectiles.

Keywords: impact, dehydration, ejecta, fragments, porosity, small bodies

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Transportation of NEOs from their source region and its dependence on collisional disruption

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The dynamical origin and evolution of Near-Earth Objects (NEOs) still have many issues yet to be solved. Recent discovery of NEO families has raised another question, indicating that the asteroid transportation efficiency from the main belt could be much lower than what has been considered. Also, how much contribution the Oort Cloud cometary objects has over the total population of NEO is not clear at all. In this presentation we will make a brief summary as to what is known and not known about the dynamical evolution of NEOs, and tries to show several ways for future studies.

Keywords: near-Earth asteroids, collisional disruption

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Dynamical evolution of captured Trojan asteroids

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The Trojan asteroids orbit the Sun about the L4 and L5 Lagrangian points of Jupiter. These objects have a wide range of eccentricities and inclinations, and are thought to be captured planetesimals. Since the origin of the Trojan asteroids is expected to provide clues to the dynamical evolution of the planets and small bodies in the Solar System, various models have been proposed, e.g., capture due to gas drag from the solar nebula, capture during Jupiter's mass growth, or capture during smooth migration of Jupiter. However, such models failed to reproduce some important characteristics of the present Trojan asteroids, such as the total mass of the Trojans, the distribution of orbital elements, or the distribution of the libration amplitudes. On the other hand, recent models for the formation of the Solar System suggest that the giant planets likely experienced significant radial migration and orbital instability after their formation. Recent studies of capture of Trojan asteroids based on such models of giant planet migration show that icy planetesimals (or KOBs) originally in the outer Solar System can be captured into Jupiter's Trojan regions. Such models successfully explain the present total mass as well as the observed orbital characteristics of the Trojan asteroids.

However, in such studies of capture of the Trojan asteroids, planetesimals were treated as test particles, thus gravitational interactions between planetesimals are not taken into account. Also, effects of mutual gravity among asteroids are also neglected in the studies of the stability of the Trojan asteroids after their capture into the Lagrangian points. Although effects of gravitational interactions between sufficiently small asteroids may reasonably be neglected, there may have been significantly large objects in the original swam of Trojan asteroids immediately after their capture. In the above-mentioned recent models of capture, Trojan asteroids likely originated from the outer region of the Solar System, including the Kuiper belt. Among the current KBOs, there are many objects that are much larger than the largest of the present Trojans, some of them being as large as 1,000km across in diameter. If such a large body is captured into the Trojan regions even temporarily, it may have a significant influence on the stability of other Trojan bodies, and some of them would be scattered out of the Trojan regions.

In the present study, we assume that a large body was captured into Jupiter's Trojan region, and examine its dynamical influence on other Trojan asteroids using orbital integration. From the results of our orbital integrations, we derive constraints on the mass of bodies existed in the Trojan swarm in the past.

Keywords: asteroids, Trojan