[JJ] Evening Poster | M (Multidisciplinary and Interdisciplinary) | M-GI General Geosciences, Information Geosciences & Simulations

[M-GI28]Development of computational sciences on planetary formation, evolution and surface environment

convener:Yoshi-Yuki Hayashi(Department of Planetology/CPS, Graduate School of Science, Kobe University), Masaki Ogawa(Division of General Systems Studies, Graduate School of Arts and Sciences, University of Tokyo), Shigeru Ida(東京工業大学地球生命研究所, 共同), Kanya Kusano(Institute for Space-Earth Environmental Research, Nagoya University)

Wed. May 23, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

Computer simulations have been recognized as one of the fundamental tools in understanding planetary formation, evolution and diversity of surface environment. However, is may be notified that the continuous development of computational abilities in recent years does not seem to be well utilized in improving numerical simulations in those fields; computational efficiency has been improved by 6 orders of magnitude compared from the early 90's, many of our simulations do not seem to catch up qualitatively and quantitatively such improvement. We propose here in this session to ask those who are interested in computational sciences of various fields not only of planetary formation and evolution but also of earth and planetary sciences in general to join. The aim is to discuss various scientific and technical aspects of our numerical simulations to improve our skills to fully utilize those development of computational resources that is realized or will be realized in near future as "K" to "post-K".

[MGI28-P03]Development of a three-dimensional mantle convection model with tectonic plates induced by stress-history dependent rheology

*Takehiro Miyagoshi[1], Masanori Kameyama[2], Masaki Ogawa[3] (1.Japan Agency for Marine-Earth Science and Technology, 2.Ehime University , 3.University of Tokyo)

Keywords:mantle convection, numerical simulations, tectonic plates, stress-history dependent rheology

In today’s Earth, solid plate interiors and ruptured plate boundaries coexist at a stress level typical for the Earth’s interior. A stress much higher than this level is necessary to rupture an intact plate and to introduce a new plate boundary. Once a plate boundary develops, however, it does not immediately disappear, even if the stress is reduced to the original level: the rheological state of a plate depends on its stress history. We reproduced tectonic plates in our three-dimensional mantle convection models calculated with ACuTEMAN code (Kameyama 2005; Kameyama et al. 2005) by introducing this stress-history dependent rheology. We discriminated the plate boundaries and plate interiors by introducing a damage parameter that depends on the stress-history that the material has experienced: this parameter takes a value less than one in intact plate interiors, but takes a large value at plate boundaries. One of the difficulties we encountered in calculating this model is the numerical instability that occurs when a fine structure with a large viscosity contrast develops along plate boundaries: The viscosity contrast becomes as large as three orders of magnitude. To avoid this difficulty, we introduced a diffusion of the damage parameter. The magnitude of the diffusion is adjusted so that it does not affect the global configuration of tectonic plates but does smear out the fine structures at plate boundaries. In the poster, we will present some examples of tectonic plates that we calculated.