Thermal Evolution and Possibility of the Early Plate Tectonics on Mars. T. Matsuyama, Tokyo Institute of Technology (I2-12, Meguro, Tokyo, 152-8550, Japan, matsuyama@geo.titech.ac.jp).

Introduction: In order to understand the evolution of planet, the interior's convection regime is essential especially since it affects the thermal evolution of the planet. Regarding Mars, previous studies investigate the evolution in the case of two convection regimes: stagnant lid regime and plate tectonic one [1]. Although Mars now holds the stagnant lid regime, several observations indicate the possibility of plate tectonics on Mars in its early stage. The conclusion still remains unclear.

Owing to the recent active exploration about Mars, we are able to obtain the various data, especially about Marftian thermal history. Previous study [2] calculated thermal evolution in the case of plate tectonics with the effect of planet size and tried to apply it to Mars. However, the result included several free parameters, like the shape of subduction zone. This study modifies the theory by considering the dichotomy and geomagnetism on Mars and compares the calculation with compiled observation about thermal history on Mars.

Plate Tectonics on Mars: While there are several observations indicating the existence of early plate tectonics on Mars, representative one is geomagnetism. The shape on the Martian crust seems to be the same origin to that on the Earth which is created at the mid-ocean ridge through the system of plate tectonics. Assuming the geomagnetic anomaly as the plate tectonic origin, this study constrained some free parameters on the theory of thermal evolution in [2].

Observation about Thermal History on Mars: Recently, there are several approaches to estimate the history of mantle potential temperature on Mars, i.e., rover, satellite, and meteorite. I compiled the data and compare the modified theory about Martian thermal evolution to investigate the possibility of early plate tectonics. The result is Fig. 1.

Discussion and Conclusion: Although Fig. 1 shows one case of Martian thermal history with plate tectonics, it indicates several remarkable points. First, both cases of thermal history with plate tectonics and without it can result in the similar thermal evolution. Second, several observation cannot be explained by those two cases. However, the gap between the calculation and the observation is acceptable when we can consider the special variation of the temperature at the volcanism. In order to comprehend the location where the samples were generated, we have to contemplate the mineralogy and geochemistry in them. Whereas ancient plate tectonics is possible from these results, we need more investigation particularly about the ancient condition on Mars in order to constrain the convection regime.

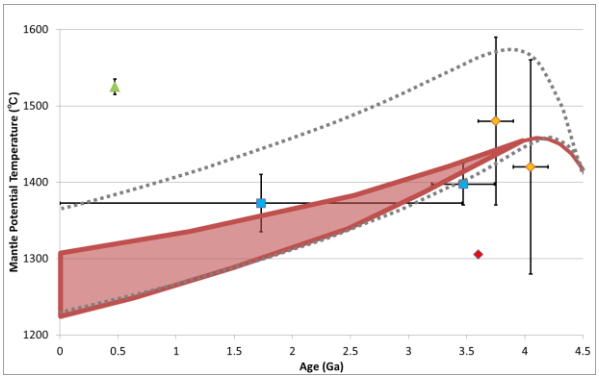

Fig. 1. Thermal evolution of Mars. Red line and shaded area express one possible case of Martian thermal history. Dashed line shows the result by conventional thermal evolution theory[3]. Red, yellow, green, and blue points show estimated Martian thermal evolution from observation [4, 5, 6, 7].

References: [1] Nimmo D. and Stevenson D. J. (2000) *JGR*, 105, 11969-11979. [2] Matsuyama T, LPSC 44, 2783, 2013. [3] Grott et al., *Space Scie rev*, 2013, **174**, 49-111. [4] Monders *et al.*, 2007, *Meteoritic & Planetary Science*, **42**, 131-148. [5] Filberto, J. & Dasgupta, R., 2011, *EPSL*, 2011, **304**, 527-537. [6] Musselwhite *et al.*, 2006, *Meteoritic & Planetary Science*, **41**, 1271-1290. [7] Baratoux et al., 2011, *Nature*, **472**, 338-341.