Subsurface hydrothermal system and the origin of Martian magnetic anomaly

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As a future exploration plan on Mars, we propose a scientific rover project to explore a subsurface hydrothermal activity with a fracture system for constraining the possible origin of strong magnetic anomaly and methane atmosphere on Mars. Geophysical gravity and magnetic inversion studies have suggested the deep origin (more than 50km) of magnetic anomaly source which is formed through the hydrothermal serpentinization of lower crustal rocks to generate ferromagnetic magnetites. Whereas, a geochemical modeling for the interaction of atmospheric carbon dioxides with crustal rocks leads to the shallower origin (less than 10km) of magnetic anomaly source which is formed through the thermal break down of siderite ($FeCO_3$) to fine-grained magnetite. To confirm the hypothesis, we are considering the use of rover to detect depth profile of hydrothermal fracture system by a magneto-telluric method in a region of strong magnetic anomaly. Magnetic anomaly region can generate fluctuation of magnetic and electric fields by the interaction between the solar wind and its magnetosphere. These natural fluctuations under magnetic field induce the electric current under the Martian surface, producing a conductivity structure of an underground fracture system with fluid. Therefore, the MT method would be a powerful tool to check the deep or shallow origin of magnetic anomaly.