Gamma Ray Spectrometer for a Mars Orbiter Mission

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One of the basic keys to an understanding of the formation and evolution of Mars is knowledge of the elemental composition of its surface. Earlier studies on Mars have aimed at the determination of the surface composition of Mars, either globally or at specific locations on the planet. The Gamma Ray Spectrometer (GRS) on the 2001 Mars Odyssey Mission used a solid-state Ge detector, which has significantly better spectral resolution than the scintillation detectors used on the prior missions. The Mars Odyssey GRS instrument (Boynton et al. 2007) provided concentration maps for the elements H, Si, Cl, K, Fe and Th for low and mid-latitudes ($\pm 45^{o}$) for the first time. However, the Fe concentrations obtained by GRS were 20% higher than measurements based on Mars landing missions (Viking, Pathfinder, Spirit and Opportunity). This is in contrast to other elemental abundance maps which agreed very well with the lander values. Thus, additional measurements of Fe are required from a Mars orbiter. Furthermore, no maps have been reported for Ca, Al, S, U, Na and Mn from Odyssey GRS data. An interesting scientific implication from Odyssey GRS data is that there exists no evidence for a globally distributed dust of homogeneous composition on Mars with a thickness of the order of tens of centimetres. This is in contrast to the idea that a globally homogenous dust or soil composition is present on Mars based on the similarities in composition of the soils at the MER, Pathfinder and Viking landing sites (Yen et al. 2005). This discordance between orbital and lander data necessitates further compositional measurements on a future Mars orbiter mission. In light of this, we propose to develop a gamma ray spectrometer ($LaBr_3$:Ce or HPGe) for the Mars orbiter being planned by ISRO. The gamma spectrometer will map naturally radioactive elements (Th, U, K), and other major and minor elements including H, O, C, Fe, Mg, K, Ti, Ca, Al, Si, S on the entire Martian surface.

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