Water history in the Mars' interior inferred from elastic thickness

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Early Mars would have enough water to cover its entire surface, perhaps paleo-ocean reaching depth greater than several hundred meters (e.g., Carr, 1966). However, such liquid water has been disappeared and the preset atmosphere on Mars becomes highly dry. Thereby, question is how and where paleo-ocean has been taken away, whereas, in Earth, ocean has been sustainably existed throughout its geological history. Water might have been escaped to space due to a relatively small gravitational energy on Mars, as indicated by an enrichment of deuterium in the present-day martian atmosphere (Villanueva et al., 2015). However, these estimates do not fully account for the water concentration inferred from surface geology such as fluvial and glacial features on Mars (Achille and Hynek, 2010). This means another water reservoir possibly existed in Mars, probably in its interior, because the water-rock interactions can result in the incorporation of large amounts of water and such processes are common in Earth. The martian elastic lithosphere estimated from gravity and topography data by the Mars Global Surveyor and other orbiters indicates a general increase of elastic thickness with age, but also indicates a regional variation depending on features. Since rock rheology is largely influenced by water (e.g., Karato and Jung, 2003), we investigate how water influence the elastic thickness based on recent rheological data, and test whether water-rich lithosphere can account for the variation of the elastic thickness observed in Mars.

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