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Salts as Indicators for the Interior Processes of Solid Planets

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1 Introduction

It has been noticed that salts link the Earth's spheres (Zheng, 2007), and rich information must have been recorded by salts on the geological processes they involved in. Salts have been found on Mars, Europa, Enceladus, and salts might be common on planets (Zheng et al., 2013). Thus salts can be potential indicators for studying the geological history of planets.

From the beginning of the 21st century, much new knowledge has been gained about planetary salts, especially for Martian salts, and studies of salts on earth have helped not only on the explorations but also on explaining the salt related processes on other planets. For example, the basic understanding of Mars geological history benefited a lot from the observation of Martian salts (Bibring et al., 2006; Murchie et al., 2009).

2 Origin of Salts

In general, salts have three major types of origins:

Sedimentary salts, originated from the surface, subsurface water-rock interaction, salt forming ions were dissolved from igneous rocks, and from various types of brines.

Magmatic or volcanic salts, brines can originate from high temperature water-rock or water-magma interaction.

Atmospheric salts, mineral particles reacts gases in the air, usually associated with photochemical processes.

Previous studies focus on extracting the planetary surface environments through the investigation of the detected sedimentary salts or surface brines. Recent finding of Martian perchlorates has driven a lot of studies on atmospheric formation of salts (Hecht et al., 2009). However, little attention has been paid to the magmatic salts or the volcanic salts so far. This abstract addresses the importance of volcanic salts or magmatic salts for planetary science.

3 Current Understanding of Planetary Salts and Potential Importance of Magmatic or Volcanic Salts

Thanks to the explorations, various kinds of salts have been found on planets other than the Earth. To our knowledge, Martian salts are dominated by sedimentary salts, including carbonates, sulfates, and chlorides). The studies of these sedimentary salts have made important contributions to understand the aqueous processes on Mars. The detection of salty oceans under the icy shell of Europa and Enceladus suggests salt formation might be common for icy bodies. And these salts should belong to be sedimentary.

The origin of magmatic salts and volcanic salts deeply involves in the interior processes of solid planets. For example, on Earth, Li and B bearing brines are proposed to be associated with volcanism or with hydrothermal activities induced by tectonic activities due to the geochemical behaviors of Li and B. Thus, these salts can be potential indicators for studying the interior processes on solid planets. Besides, if a planet with volcanism existed in its geological history, like the moon, is completely free of salts (Jolliff et al., 2006), the bulk chemistry of its pristine materials must be special in certain sense, such as lack of hydrogen. Although it's constrain on the chemical composition of the pristine materials of Moon need to be clarified, possibly by combining geochemical modeling and field observation of volcanic activities on Earth in the future, which will be very important for better understanding the origin of the Moon (Canup and Righter, 2000).

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