Analyzing Magnesium Isotopic Composition of Martian Meteorites with Inductively Coupled Plasma Mass Spectroscopy

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Background

- Magnesium isotopes from meteorites are used to study the Mg isotopic composition of the Solar System.
- There are three stable Mg isotopes,
  - ^{24}Mg (78.99%)
  - ^{25}Mg (10.00%)
  - ^{26}Mg (11.01%) [2]
- Geology of Mars:
  - Surface is mainly basaltic [3]
  - Early history of volcanism and bombardment [1]
  - Early fractionation and differentiation of the mantle and core. [1,3]

Methods

- The Mg isotopes are collected from columns by cation exchange chromatography.
- The samples are put in the MC-ICP-MS (multi-collector inductively coupled plasma mass spectrometer) for the isotopic analysis.
- The preliminary results are reported here.
- About 32 samples from Martian meteorites and 12 terrestrial samples were collected and are ready for MC-ICP-MS analysis.

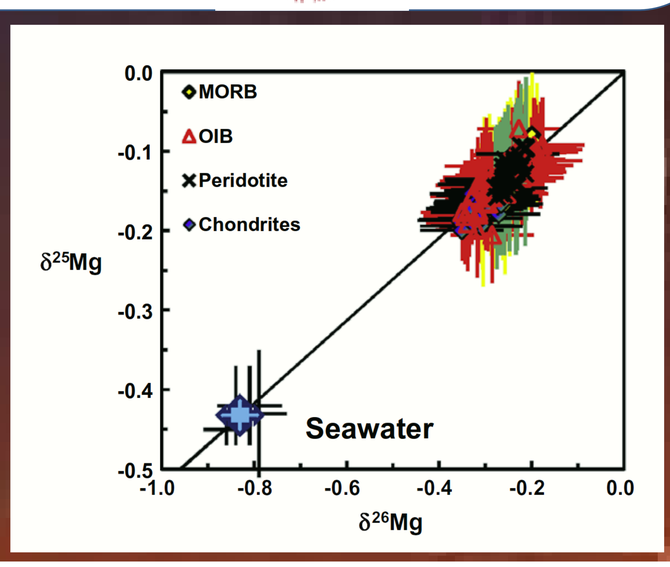


Figure 2: All the samples including chondrites with a very précised value of the $\delta^{26}Mg/\delta^{25}Mg$ ratio. [4]

Objectives

- To determine the magnesium isotopic composition of Mars.
- To see if Mars have the same isotopic composition as Earth and the Moon.

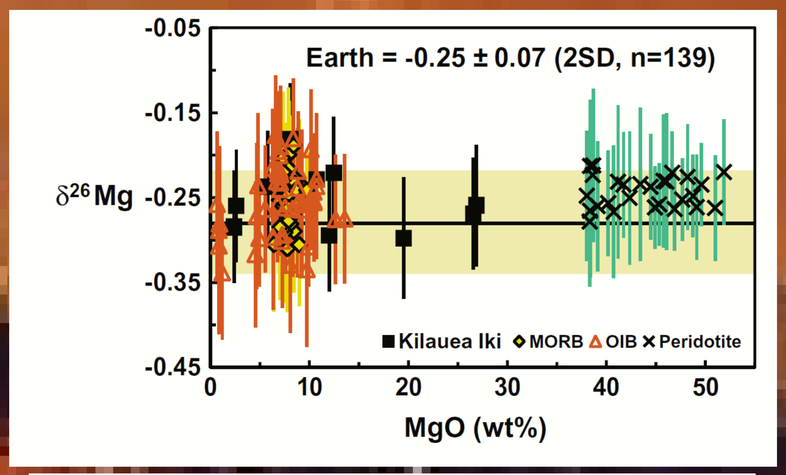
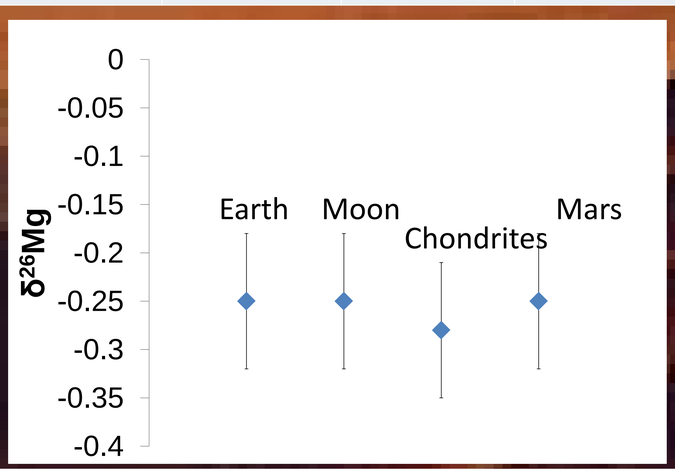


Figure 1: The $\delta^{26}Mg$.VS. MgO in all terrestrial samples and chondrites have the same average $\delta^{26}Mg$. [4]

Results

Distance from Sun	Space Object	$\delta^{26}Mg$	2SD
1	Earth	-0.25	0.07
2	Moon	-0.25	0.07
3	Chondrites	-0.28	0.07
4	Mars	-0.25	0.07



This graph shows the amount of $\delta^{26}Mg$ on Earth, Moon, Mars, and Chondrites from previous research on this table.

Conclusion

- According to the data, Mars has the same magnesium isotope composition as Earth and the Moon with the average $\delta^{26}Mg$ of -0.25.
- If the Moon, Earth, and Mars have the same Magnesium isotopic composition, then that would mean that all the planets in the Solar System would have been made by chondritic material.
- The Mg isotopic analysis of the Martian Meteorites and terrestrial samples gives us a better understanding of the formation of the Solar System.

References

[1] McSween, Harry. (1994) Meteoritics, 29, 757-779. [2] Teng, F.-Z., et al. (2007) Earth and Planetary Science Letters, 261, 84-92. [3] McSween, Harry et al. (2009) Science, 324, 736-739. [4] Teng, F.-Z., et al. (2010) Geochim. Cosmochim. Acta, 74, 4150-4166. [5] Marty, B., et al. (2002) Earth and Planetary Science Letters, 196, 251-263.

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