Press Release

(with Details)

April 16, 2010

Significant Uranium and Other Discoveries on the Moon May Indicate New Space Race is Afoot

by

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and

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The indication of significant uranium on the Moon reported by Japanese researchers last year could have wide implications to international relations and to the U.S. space program now and in the new future. The Japanese Kaguya spacecraft, which was launched in 2007, has detected significant uranium with a gamma-ray spectrometer. Kaguya, officially named SELENE ("Selenological and Engineering Explorer"). The orbiter was purposely crashed into the lunar surface at the end of its mission in June, 2009 to provide information on the possible occurrence of water ice on the Moon (see Britt, 2010).

Results obtained during the SELENE mission of exploration not only suggest the presence of water ice in the dark craters on the Moon but also indicate that anomalously high uranium, thorium, and iron may be present, which together infer that certain other strategic commodities may be present as well. Uranium appears to be present in significant pathfinder concentrations over a wide area in Procellarum KREEP Terrain and perhaps in the South Pole Aitken Basin, likely as near-surface remnants of asteroid impacts in the areas, see Yamashita, *et al*., 2009; and Gasnault, *et al*., 2009). Similar anomalies on Earth would receive serious attention by uranium and other mineral exploration companies.

Focusing in part on these findings, a chapter is to be published in 2013 as part of Memoir 101 by the American Association of Petroleum Geologists (AAPG) and produced by members of the AAPG's Astrogeology Committee and of the Energy Minerals Division. The AAPG-EMD Memoir 101 will be available via the AAPG (here), and will contain nine chapters on developing resources in space (for Table of Contents, see here). This information is released now because the Memoir reviews the current uncertainties in NASA programs being considered by President Obama.

Any discovery of off-world uranium and thorium in potentially economic concentrations and tonnage would have a major impact on nuclear-power development on Earth and accelerate lunar exploration. This may well result in a new space race among international interests to develop mineral resources on the Moon. High-grade uranium deposits found on Earth that may have analogies on the Moon are likely those found in Canada and northern Australia (Jefferson, *et al*., 2007). The ore-body tonnage and associated ore grade may need to be higher than those found on Earth before economic advantages are likely to justify off-world development.

The metal-rich impact sites known on Earth also have off-world analogs (see Campbell, *et al.*, 2009a). On the Moon, for example, early indications of anomalous sites containing high levels of thorium (Figure 1) samarium (Figure 2) and recently uranium (Yamashita, *et al*., 2009) should be on NASA's list for follow-up investigations when the U.S. returns to the Moon with manned missions, assuming China, India, Russia or other countries do not claim the sites first. Recent discoveries of anomalous uranium and other commodities on the Moon may change the political dynamics in space, especially with Iran and others recently demonstrating an interest in space (Yamashita, 2009, and see Figure 1). Combine that with China's increasing claim on strategic minerals on Earth (such as samarium and other rare-earth minerals), these commodities play an important role in the world's economic development today. Recent estimates suggest that these minerals will be in short supply in the decades ahead (see Hsu, 2010), and off-world resources of these commodities will also receive attention by those national interests exploring the Moon and asteroids.

We see a particular irony in the role that meteor and comet impacts may have played in bringing not only water to Earth, but also metals of economic value, such as nickel, uranium, thorium, etc. As previously discussed, areas in and around certain lunar impact craters have been found to contain thorium, uranium, and samarium. On Earth, economic concentrations of nickel and other constituents of interest have been found near Sudbury in Ontario, in the Bushveld-Vredefort structures in South Africa and others in association with ring structures in Baltic Shield rocks of Sweden and Finland and elsewhere. They are tempting candidates for being of off-world origins, although the prevailing thought is that such deposits on Earth are either of progenetic (pre-impact), syngenetic (contemporaneous), or epigenetic (post-impact) origin. For the history and evolution in thought, see Grieve, 2005; Reimold, *et al*., 2005; Laznicka, 1999; Witschard, 1984; and of historical note, Skerl, 1957, and Quirke, 1919).

Currently, there are about 170 terrestrial impact structures presently known on Earth, with a discovery rate of about five new structures per year (see PASSC, 2009), especially in Pre-Cambrian rocks. In any event, exploration continues in the more remote regions on Earth, and will continue off-world this century and beyond (see Campbell, *et al.*, 2009a and 2009b). The justification for continuing the move into space has been well made by Yeomans (1998), and many other geoscientists.

Recent exploration discoveries on the Moon by Japan may accelerate activities by China, India, Japan, and the U.S. (Yamashita, 2009). As suggested, this may well set off a new race into space and to the Moon specifically to establish bases to explore for and develop natural resources "nearby" including water (from dark craters to make hydrogen for fuel and oxygen, etc.), nuclear minerals (uranium, thorium, and helium-3), rare-earth minerals, and other industrial commodities needed for use in space and on Earth. Missions to Mars and asteroids along the way should be scheduled after the technology involved in off-world bases on the Moon has been proven with experience to be viable ventures.

But until some form of fusion or advanced solar technology is available sometime in the future, the nuclear resources (uranium and thorium) are needed today and in the foreseeable future to drive the nuclear power-generating systems on Earth. This depends on the results of exploration on Earth and of technological development in current and future missions to the Moon and elsewhere for developing not only uranium but also other minerals of strategic interest to the U.S. Other countries have clearly announced their intentions to explore the Moon for minerals of strategic interest.

Additional information is available in reports from industry geoscientists of the EMD's Uranium (Nuclear Minerals) Committee (more), for a summary version of the Press Release (here) and from AAPG's Astrogeology Committee (more).

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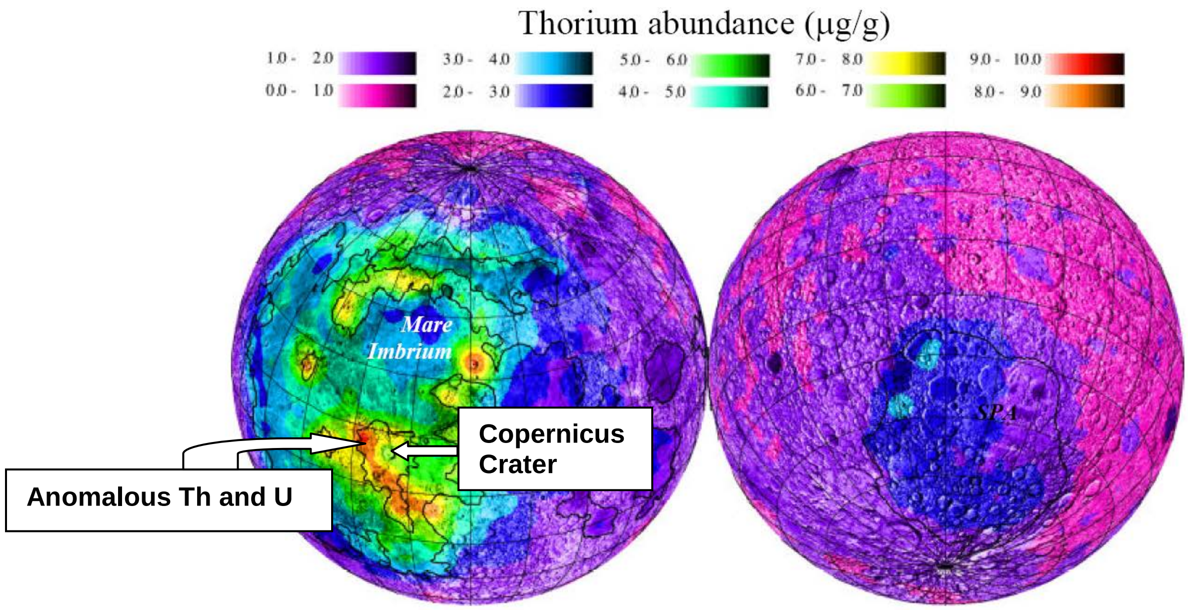
Figure 1 – Inferred Thorium Abundance on a Two-Hemisphere Map Projection. (For Th and Sm From Elphic, *et al.*, 2000. and for U and Th from Yamashita, 2009)



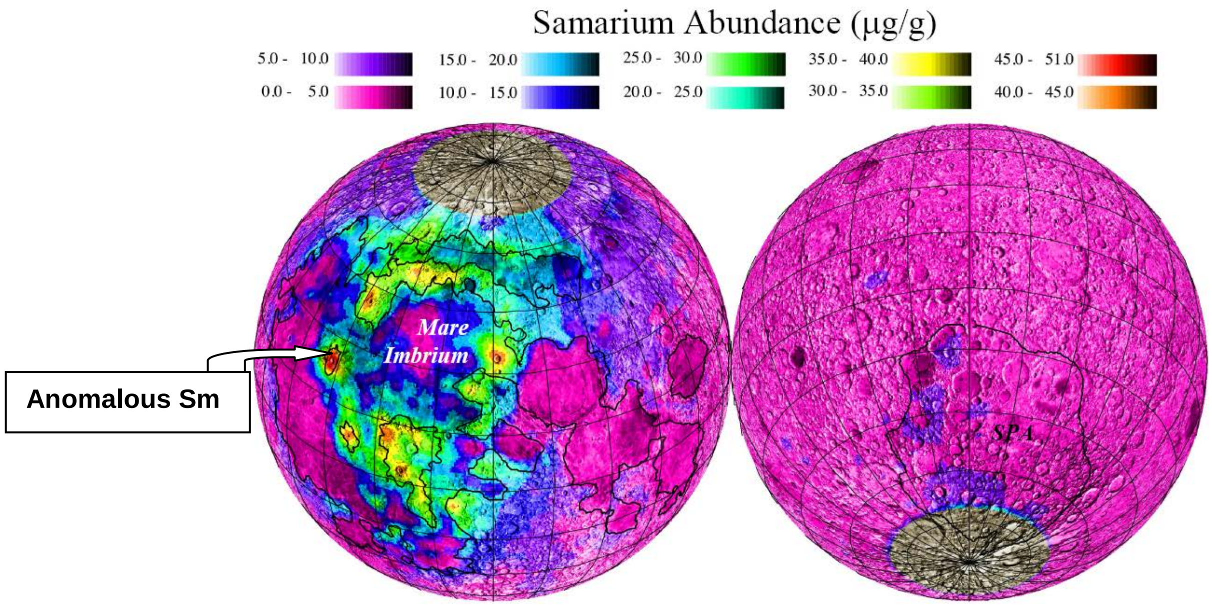


Figure 2 - Inferred Samarium Concentrations in the Imbrium/Procellarum Regions. From Elphic, *et al.*, 2000.

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