Development Zone: Hyginus-Iron

Number: 1035

Resources Profile

The Hyginus Iron Development Zone is established in the territory of lunar mare craters Hyginus N and Hyginus G, which are located on the near side of the Moon.

The Hyginus Iron DZ is formed by mare basalt, whose structure is made of minerals such as plagioclase, pyroxene, olivine and iron-titanium oxides like ilmenite.

Lunar plagioclase, being the most abundant mineral in the lunar crust, is depleted in Na. The most commonly occurring pyroxenes are hypersthene, augite and pigeonite. Olivines contain such significant elements as Mn, Ca, Ni, Cr and Al. Ilmenite magma, the higher the ilmenite content of the rock. Ilmenite forms as much as 15-20% by volume (on the example of Apollo 11 and 17 mare basalts).

The 1994 Clementine UV/VIS images show that the wt% FeO in this area is around 20.

Mare basalts have the biggest potential of hosting iron. The concentration of iron in the regolith is on average 15 wt% (the maximum measured was 17 wt%). Native iron in the regolith is usually in the form of grains of 1 – 100 μm size and is found in all lunar breccias. The source of the metal iron is usually other than from the lunar rocks – possibly from asteroidal meteorites. This type of iron consists of alloys containing several percent of nickel and some cobalt.

There are several potential ways of extracting iron from the lunar regolith. It can be produced e.g. during the process of hydrogen reduction of ilmenite, which will produce metallic iron, but also titanium oxide, which would require further processing. Another way would require using a magnet which would allow the meteoritic metals to be extracted from the regolith. There is also an idea to extract lunar iron microbially with use of self – reproducing bacteria Shewanella oneidensis. Finally, another method could be electrolysis of molten silicates.

Further reading:

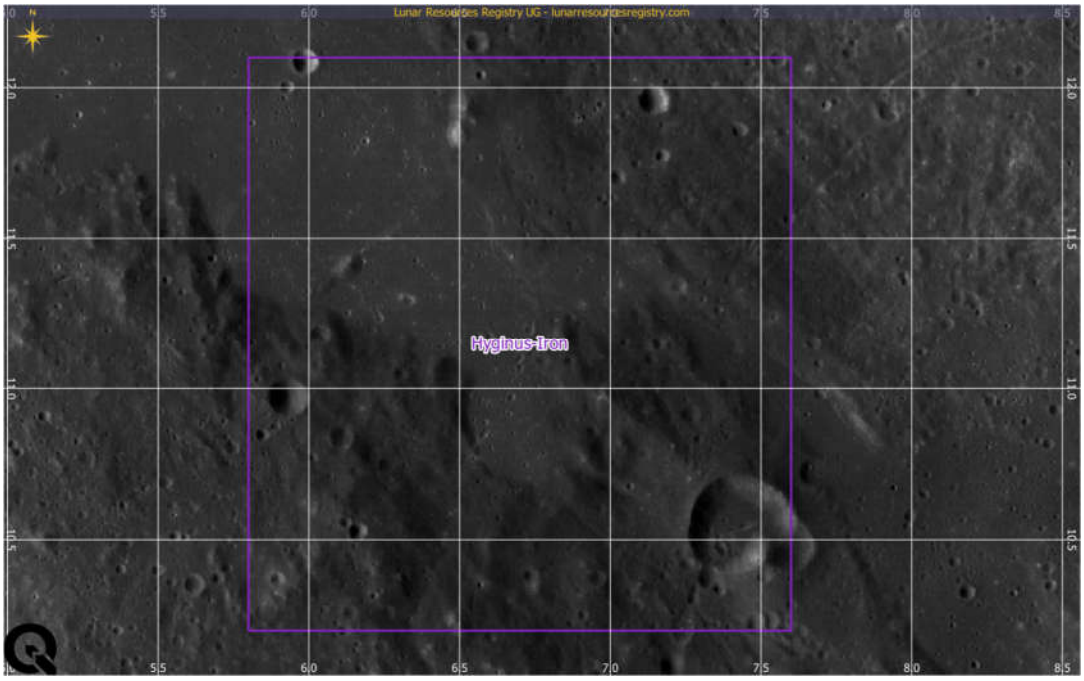
1. “The Constitution and Structure on the Lunar Interior”, Mark A. Wieczorek et al., Mineralogical Society of America geochemical society, Reviews in Mineralogy & Geochemistry Volume 60, 2006
2. “Thermal and Magmatic Evolution of the Moon”, Charles K. Shearer et al., Mineralogical Society of America geochemical society, Reviews in Mineralogy & Geochemistry Volume 60, 2006
3. https://www.biorxiv.org/content/10.1101/2020.11.15.382614v1.full
4. https://www.lpi.usra.edu/meetings/lpsc2013/pdf/2276.pdf
5. https://www.lpi.usra.edu/publications/books/lunar_bases/LSBchapter07.pdf
6. “Lunar Minerals”, James Papike, Lawrence Taylor, Steven Simon, 2012

Registration Development Status:

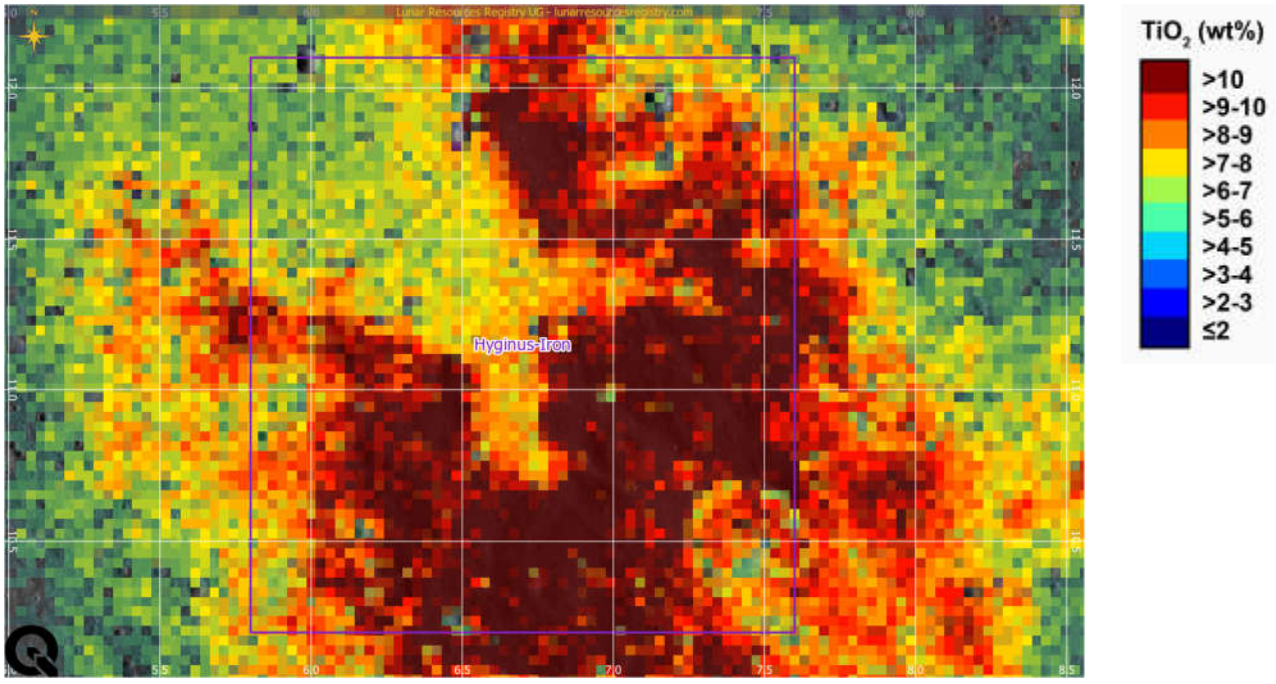
Lunar Resources Registry has identified this area as a Development Zone.

Maps

Hyginus with Base Map. Source: LRR

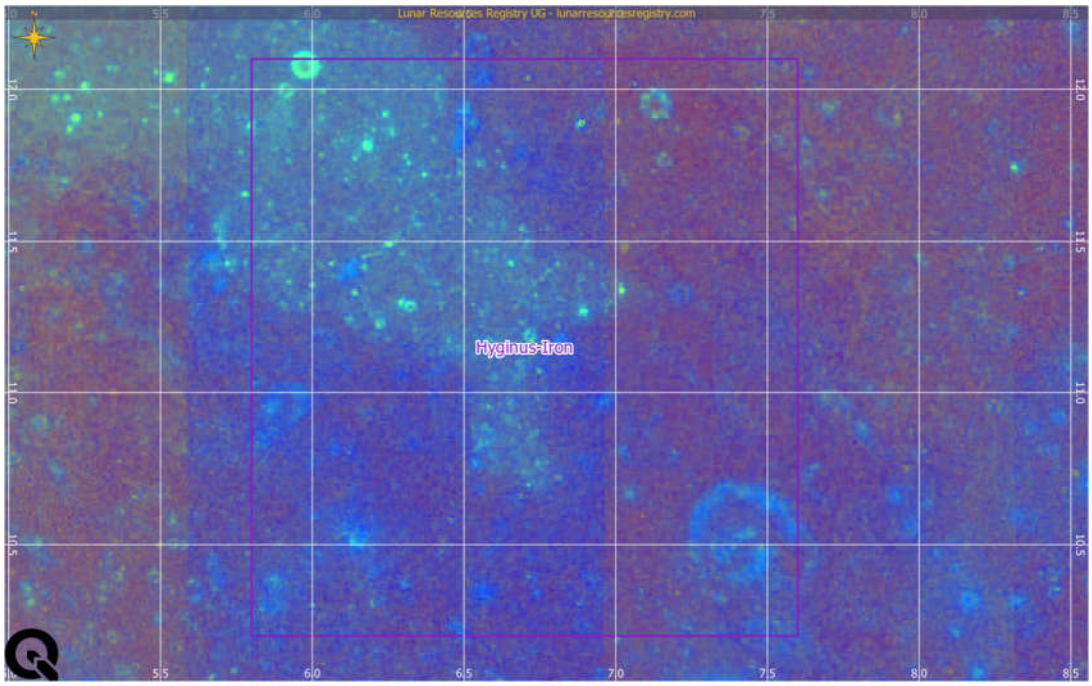


LROC WAC TiO2 Abundance

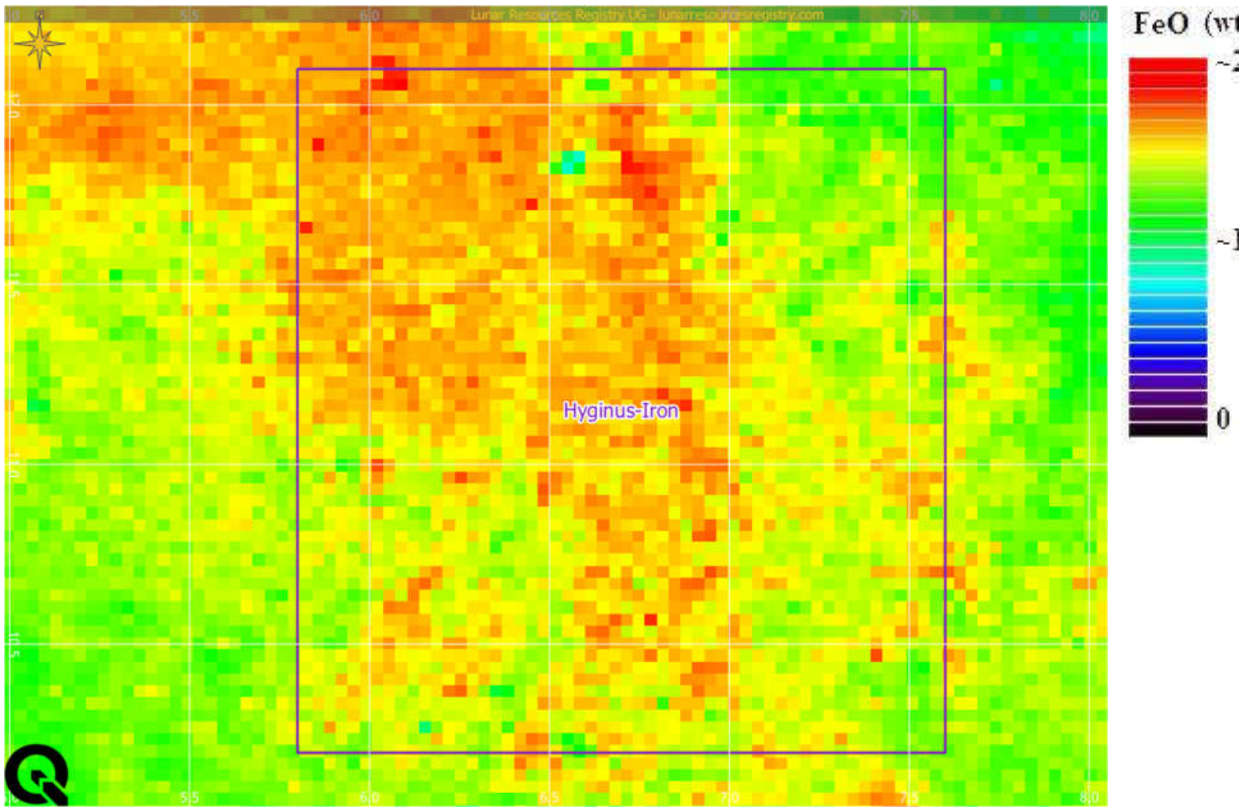


Source: LRR Resources Moon Map

Clementine



Lunar_Clementine_UVVIS_FeO_ClrBinned_70S70N_1km



Kaguya FeO Abundance(wt%)