MIT Technology Review

Mining the Moon

Lab experiments suggest that future fusion reactors could use helium-3 gathered from the moon.

By Mark Williams on August 23, 2007

At the 21st century's start, few would have predicted that by 2007, a second race for the moon would be under way. Yet the signs are that this is now the case. Furthermore, in today's moon race, unlike the one that took place between the United States and the U.S.S.R. in the 1960s, a full roster of 21st-century global powers, including China and India, are competing.

Even more surprising is that one reason for much of the interest appears to be plans to mine helium-3–purportedly an ideal fuel for fusion reactors but almost unavailable on Earth–from the moon's surface. NASA's Vision for Space Exploration has U.S. astronauts scheduled to be back on the moon in 2020 and permanently staffing a base there by 2024. While the U.S. space agency has neither announced nor denied any desire to mine helium-3, it has nevertheless placed advocates of mining He3 in influential positions. For its part, Russia claims that the aim of any lunar program of its own–for what it's worth, the rocket corporation Energia recently started blustering, Soviet-style, that it will build a permanent moon base by 2015-2020–will be extracting He3.

The Chinese, too, apparently believe that helium-3 from the moon can enable fusion plants on Earth. This fall, the People's Republic expects to orbit a satellite around the moon and then land an unmanned vehicle there in 2011.

Nor does India intend to be left out. (See "India's Space Ambitions Soar.") This past spring, its president, A.P.J. Kalam, and its prime minister, Manmohan Singh, made major speeches asserting that, besides constructing giant solar collectors in orbit and on the moon, the world's largest democracy likewise intends to mine He3 from the lunar surface. India's probe, Chandrayaan-1, will take off next year, and ISRO, the Indian Space Research Organization, is talking about sending Chandrayaan-2, a surface rover, in 2010 or 2011. Simultaneously, Japan and Germany are also making noises about launching their own moon missions at around that time, and talking up the possibility of mining He3 and bringing it back to fuel fusion-based nuclear reactors on Earth.

Could He3 from the moon truly be a feasible solution to our power needs on Earth? Practical nuclear fusion is nowadays projected to be five decades off–the same prediction that was made at the 1958 Atoms for Peace conference in Brussels. If fusion power's arrival date has remained constantly 50 years

away since 1958, why would helium-3 suddenly make fusion power more feasible?

Advocates of He3-based fusion point to the fact that current efforts to develop fusion-based power generation, like the ITER megaproject, use the deuterium-tritium fuel cycle, which is problematical. (See "International Fusion Research.") Deuterium and tritium are both hydrogen isotopes, and when they're fused in a superheated plasma, two nuclei come together to create a helium nucleus–consisting of two protons and two neutrons–and a high-energy neutron. A deuterium-tritium fusion reaction releases 80 percent of its energy in a stream of high-energy neutrons, which are highly destructive for anything they hit, including a reactor's containment vessel. Since tritium is highly radioactive, that makes containment a big problem as structures weaken and need to be replaced. Thus, whatever materials are used in a deuterium-tritium fusion power plant will have to endure serious punishment. And if that's achievable, when that fusion reactor is eventually decommissioned, there will still be a lot of radioactive waste.

Credit: Fusion Technology Institute-University of Wisconsin-Madison

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