

Re: Proposed sample return mission to Phobos

Source: <http://sci.tech-archive.net/Archive/sci.space.policy/2007-02/msg00711.html>

- *From:* "Michael Turner" <leap@xxxxxxx>
 - *Date:* 18 Feb 2007 22:22:15 -0800
-

On Feb 18, 1:33 am, "Michael Turner" <l...@xxxxxxx> wrote:

On Feb 17, 4:49 am, "Paul F. Dietz" <d...@xxxxxxx> wrote:

Michael Turner wrote:

"The added advantage of the microwave thruster is the potential duality of the system. In 1985, Dr. T. Meek of the Los Alamos National Laboratory (LANL) demonstrated the ability to extract water from simulated lunar soil using 2.45 GHz microwaves [12]. Microwaves readily couple to the water trapped in soils. According to Meek, using conventional means to heat the soil would require 10,000 times more energy than using the microwaves to selectively heat the water in the soil.

First, I didn't write that, the authors of the paper did.

This is absurd. Microwaving lunar soil will not selectively heat water.

No, but it will heat the water even as it heats other things in it. Water is 10–20%, presumably, of Phobos. What's the fraction of other compounds subject to heating? Is it significant?

Microwaves at that frequency will predominantly interact with lunar soil by heating extremely small metal inclusions.

Re: Proposed sample return mission to Phobos

Is that better or worse for getting water out? Also consider context: whatever Meek said, he was talking about lunar soil, not Phobos regolith, which is assumed to be water-rich for purposes of this discussion.

What water there is in lunar soil is trapped in minerals, not in macroscopic droplets, so any heat deposited into it would cause bulk heating anyway.

Presumably with some loss of efficiency. I'm no big fan of trying to get water out of lunar soil anyway — it's very dry. However, if you're talking about some substance that's 10–20% water, shouldn't the behavior be different? I.e., you'd get bulk heating, but wouldn't you get a lot more water release? Maybe rather than fusing into something like glass, as with lunar soil, it would popcorn somewhat, releasing water vapor in the process?

Oh, and in case you didn't know, 2.45 GHz microwaves don't heat water by some resonance effect.

Yes, you're right, it's dipole heating. But whatever — let's go back to the question: can you use microwaving to get significant amounts of water out of carbonaceous chondrites with relatively little energy input compared to other methods?

The main industrial purpose for extracting water from rocks, AFAIK, is in drying coal before burning it. They don't use microwave heating to do that, probably because it's both inefficient (more energy would go into it than would be saved) and a combustion threat. However, water is not a precious substance on Earth.

—michael turner

Oops — it appears I was wrong about using microwave heating to dry coal. It's been done. And it's touted as efficient.

http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=7004080

And some companies even see distilling as a win (water is actually fairly precious in some Australian mining operations):

<http://www.angloamerican.co.uk/static/reports/2006/rts/mc-research-development.htm>
<http://www.solve.csiro.au/1105/article13.htm>

It appears that the issue of undesired combustion can be managed by

Re: Proposed sample return mission to Phobos

Re: Proposed sample return mission to Phobos

using low frequency microwaves. (Not really an issue for getting water from chondrites.)

Water content of coal varies, but overlaps the range for water-rich chondrites. If there's a big difference, it's probably that coal is more permeable to water vapor. There may be no alternative to finely powdering chondritic regolith to get most of the water out. (On the assumption that much of the water in regolith that's already a fine powder has sublimated away.)

–michael turner