

SECOND INTERNATIONAL WORKSHOP ON PENETROMETRY IN THE SOLAR SYSTEM

Proceedings of a Workshop
held at the
Space Research Institute, Austrian Academy of Sciences, Graz, Austria
25-28 September 2006

This workshop brought together workers in the narrow confluence of diverse fields that constitute solar system penetrometry. Specifically, this refers to the emplacement of instrumentation at low or high speed into the surface of a solar system body, and the recovery of information about that surface, usually its mechanical and thermal properties and its composition. The distinction was re-iterated, but sometimes ignored, that a ‘penetrometer’ is an instrument, inserted at low speed, while a ‘penetrator’ is a high speed, ballistic vehicle (although a mole is self-propelled, hence a low speed vehicle; as its advance allows to infer some mechanical soil properties, it is also an instrument).

While the first workshop, in 1999, was devoted largely to theoretical methods, historical discussion, laboratory work and future plans, the second workshop featured much discussion of the actual results from the *Huygens* impact on Titan’s surface, together with anticipation of results from *Philae*, the Rosetta lander now in flight, and wheel indentation studies from the *Mars Exploration Rovers*. The Mars projects featuring penetrators and moles that had flown in the intervening years, namely *DS-2* and *Beagle-2* respectively, sadly failed to land nominally and to return data. Participants look forward hopefully, as they did in 1999, to the realization of penetrators to the Moon or perhaps Europa.

A new theme in the workshop was a biological one. By coincidence, the presentations of the two authors of this preface both featured ‘cat litter’ (or sepiolite, which is itself a mineral!) or measurements thereon; several talks considered self-penetrating moles, and one biomimetic drill concept presented was specifically inspired by the two-part ovipositor drill of the wood wasp. It was realized by the participants that one particular problem faced in penetrometry (especially in low gravity environments) is how to cope with the reaction forces generated during penetration, and that perhaps submarine mammals may have evolved a solution to this problem. (We ourselves have since researched this topic — we note with interest that dolphins mate face to face, and that a male dolphin may have some prehensile control of his reproductive organ, which is normally recessed in a genital slit to minimize drag. The reaction force problem, however, seems to be addressed by locking flippers by hydrodynamically generating lift in a forward swim — techniques that sadly offer us little utility for spacecraft work.)

The workshop was hosted by the *Space Research Institute* in Graz, which offered its convenient and appreciated facilities and services. The workshop featured three days

of presentation among the more than 20 participants from nine countries. These three days were spread over four calendar days, allowing ample time for discussion. Next to discovering and admiring the heart of the beautiful city on the Mur, as well as allowing a congenial excursion to a chocolate factory proposed quite ‘high speed sampling tests’. It was noted by several participants that a considerable literature exists on the penetrometry of foodstuffs, the technique being used for example to determine the fat content of cheese. A nearby castle revealed an impressive collection of medieval penetrometers.

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Figure 1: Some medieval penetrometers.