EPSC Abstracts
Vol. 7 EPSC2012-586 2012
European Planetary Science Congress 2012

Some recent lunar science and exploration results using SMART-1 archives

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Abstract

We highlight some results from combined data analysis using SMART-1 archive with other recent lunar missions.

1. Introduction

SMART-1 demonstrated the use of Solar Electric Propulsion for deep space, tested new technologies for spacecraft and instruments miniaturisation, and provided an opportunity for science [1-12] until impact on 3 September 2006. To date, 75 refereed papers and more than 325 conference or technical papers have been published based on SMART-1 (see ADS on SMART-1 scitech website). The SMART-1 data are accessible on the ESA Planetary Science Archive PSA [13]

2. Recent SMART-1 archive results

Recent results using these SMART-1 archives combined with other data include: multi-angular photometry of Mare and specific regions to diagnose the regolith roughness and to constrain models of light reflection and scattering [14] and compared to laboratory granular photometric studies [15]; the lunar North and South polar illumination was mapped and monitored over the entire year, permitting to identify “SMART-1 peaks of quasi-eternal light” and to study their topography [16, 17]; SMART-1 was also used for radio occultation experiments [18], and positioning reduction of SMART-1, Change’E1 and 2 VLBI tracking data were performed [19]; the X-Ray Solar Monitor studied the Sun as a flare star in conjunction with GOES and RHESSI [20,21]; SMART-1 SIR data were combined with HySI data from Chandrayaan-1 to study the composition of the central peak of craters [22]; the SMART-1 impact observed from Earth was modelled using laboratory experiments predicting the size of asymmetric crater and ejecta [23] in comparison with Kaguya and LCROSS impacts. The SMART-1 archive observations have been used to support Kaguya, Chandrayaan-1, Chang'E 1, the US LRO and to characterise potential sites relevant for lunar science and exploration.

3. SMART-1 vs ground truth

Sinuous rilles are probably the most recognisable of small volcanic features on the Moon.The rilles mark lava channels or collapsed lava tubes that formed during mare volcanism.

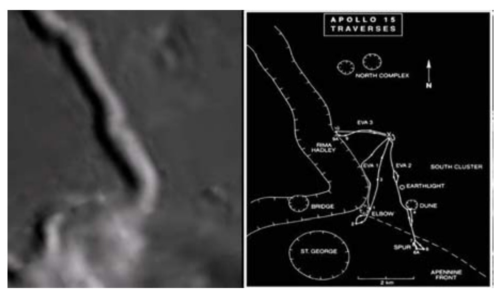

Fig. 1: SMART-1 views Hadley Rille near Apollo 15 landing site. SMART-1/AMIE obtained this image from an altitude of about 2000 km. It covers an area of about 100 km and shows the region around Hadley Rille centred at approximately 25° North and 3° East. A zoom of SMART-1 image of the Hadley rille is compared to the sketch of Apollo 15 traverses (Foing et al 2012).

The Hadley rille is over 120 km long, and up to 1500 m across and over 300 m deep in places.

The rille formed nearly 3.3 Gyr ago. In contrast, lava channels on Hawaii are usually under 10 km long and are only 50-100 m wide. The Hadley C crater next to the rille is about 5 km in diameter. The valley between these two peaks is fairly well known because NASA astronauts David R. Scott and James B. Irwin landed there during the Apollo 15 mission in 1971. The landing site is near the upper right part of the rille (26.1° North and 3.9° East) on a dark mare plain called Palus Putredinis (Marsh of Decay).

4. Acknowledgements

We thank G.Racca and SMART-1 Project team, O.Camino and SMART-1 spacecraft operations team, D.Frew and Science and Technology Operations Coordination (STOC), D.Koschny, B.Grieger, M.Almeida, J.Volp, D.Heather, H.Metselaar, S.Martinez and members of SMART-1 Science and Technology Working Team as well as their supporting organizations, including J.-L.Josset, S.Beauvivre, M.Grande, J.Huovelin, H.U.Keller, U.Mall, A.Nathues, A.Malkki, G.Noci, P.McMannamon, Z.Sodnik, B.Kellett, P.Pinet, S.Chevrel, P.Cerroni, M.C.de Sanctis, M.A.Barucci, S.Erard, D.Despan, K.Muinonen, V.Shevchenko, Y.Shkuratov, C.Veillet, P.Ehrenfreund, M.Ellouzi, S.Peters, A.Borst, F.Bexkens, G.Davies, W.van Westrenen, E.Martellato for their contribution.

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SMART-1 Scitech websites: sci.esa.int/smart-1

SMART-1 public websites: www.esa.int/smart-1