RADAR IMAGING OF IMPACT CRATERS BY SIR-C/X-SAR. Blumberg[1], D.G., J.F. McHone[1], R. Kuzmin[2], and R. Greeley[1] [1]Department of Geology, Arizona State University, Tempe, AZ 85287-1404, [2]Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow, Russia.

Summary: Radar images of three impact craters (Zhamanshin, Roter Kamm, and Wolf Creek) were imaged by the Spaceborne Radar Laboratory (SRL) flown aboard the Space Shuttle Endeavour. Early analysis of these images is discussed showing advantages for radar imaging of impact craters.

In April and October 1994 Space Shuttle Endeavour orbited Earth with the Spaceborne Radar Laboratory containing two radar systems: NASA's **SIR-C** polarimetric radar operating at L and C bands (λ=24 and 5.6 cm) and a joint German/Italian instrument **X-SAR** operating at X-band (λ=3 cm). Among some three hundred terrestrial sites targeted for various studies were three known impact craters; Roter Kamm, Namibia; Wolf Creek, Australia; and Zhamanshin, Kazakhstan. Additional impact craters may have been fortuitously imaged along with the many other planned targets. Impact cratering is an important planetary process which gives insight into the age, resurfacing rate, and evolution of all planetary bodies [1]. Radar remote sensing of impact craters holds many advantages as demonstrated by [1] and [2]. Foremost is the ability to penetrate sand mantles and to identify an otherwise concealed crater rim or ejecta blanket. Radar can also provide a 'surface roughness' map which can highlight the different weathering patterns established in an area damaged by an impact event and in the surrounding substrate. Finally, radar can penetrate clouds and certain vegetation to produce images of surface features in areas which confound systems using visible or infra-red radiation.

To date, only low-resolution reconnaissance 'survey' versions of SRL-1 mission products have been analyzed for impact crater sites. Roter-Kamm (27.76° S; 016.3° E) is a 2.4 km diameter circular structure in the Namib desert. Formed in Precambrian granitic rock, the crater is surrounded by a narrow raised rim and is partly covered by active windblown sand. An impact origin was first proposed by Dietz [3] and later confirmed by Fudali [4]. Koeberl et al. [5] noted bomb shaped impact melt breccias on the rim, suggesting that ejecta and other fragmented impact materials are preserved. Although terrain surrounding the crater is mantled with sand, a relatively bright (compared to the surrounding terrain) radar-visible halo appears in the image as far as 2.5 km to the south and west and ~1.5 km to the north and east (Fig. 1). This bright halo probably represents buried ejecta blocks reflecting radar energy that penetrated the sand. Roter-Kamm is covered by two data-takes obtained with opposing look directions.

Florenskiy and Dabizha [6] describe Zhamanshin impact crater [48.33° N, 61.0° E] in the North Aral region. The crater is considered to have formed some 700,000 years ago in an event which melted and evaporated large masses of target material. Superheated glass fragments and droplets are widely distributed around the crater. Following the impact, it is suggested, this material condensed from an incandescent cloud of silica vapors and aerosols to form a rain of glassy particles on the ground. The crater is 6.5 km in diameter and has the appearance of a rounded, flat depression slightly inclined to the east. The distribution of breccia in the crater area is asymmetrical forming a butterfly shape. Also, an anticline with a radius of 30 km is outlined around the crater. Despite its geologic youth, this impact site is relatively obscure on nearly all existing orbital images; it is difficult to recognize without knowledge of location and shape. On the survey-quality SRL-1 data in this study, Zhamanshin is manifested only as a subtle general increase in radar brightness, representing an increased surface roughness, in the area of the crater. Full resolution polarimetric data may prove useful in quantifying the extent of the roughness variations and other new information.

Wolf Creek [19.3° S; 127.77° E] in West Australia is an almost perfectly circular structure with a rim diameter of ~900 m. Outer slopes of the crater rise 35 m above mean ground level and late Precambrian quartzites are exposed within the central bowl. Shale balls (weathered meteoritic iron) found in clusters near the crater are welded into some lateritic soils. The region around the crater is covered by sand dunes. The northwest part of the crater appears brighter than the southeastern area, probably due to a combination of vegetation and look direction effects (energy returning from dune slopes). As full-resolution data become available we plan to study the interaction of sand mantles with radar for the purpose of evaluating wind streak features on Magellan SAR images of craters on Venus.

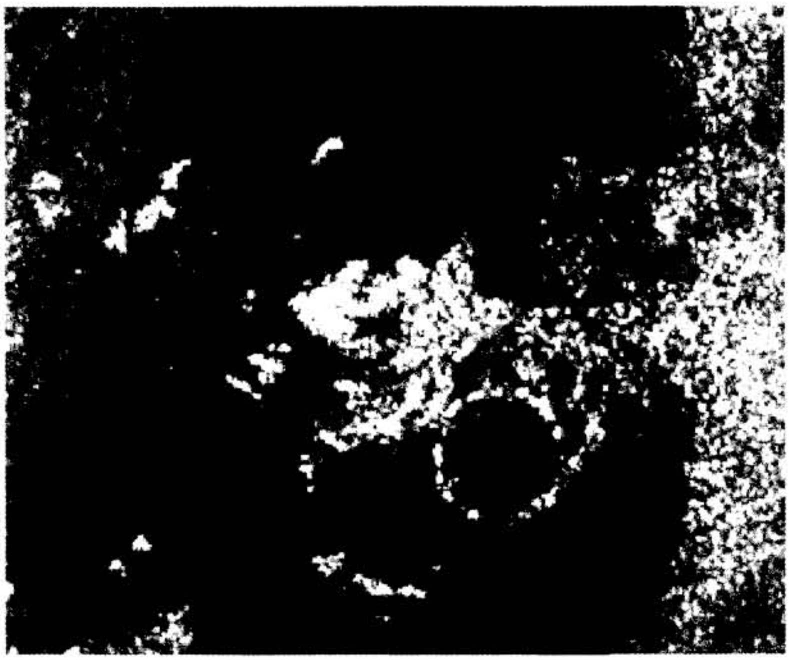

Fig. 1. Roter Kamm impact crater, located in the Namib Desert of Southern Africa was imaged during SRL-1. The crater is 2.4 km in diameter and seen as the circular feature in the above image. Radar images show a bright halo around the crater which is probably due to radar reflectance off ejecta blocks mantled by sands-- this is not seen in visible images. SRL-1 image of the crater DT 148.4.

References cited:

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