MORPHOLOGIC MAPPING OF BECQUEREL CRATER, MARS AND COMPARISON OF LIGHT-TONED LAYERED DEPOSIT FORMATION THEORIES. J. Ehrlich, C. Gross, Freie Universität Berlin, Institute of Geological Sciences, Planetary Sciences and Remote Sensing; Malteserstr. 74–100, D–12249 Berlin, Germany; jens.ehrlich@fu-berlin.de

Introduction: Becquerel crater is a 167 km large complex impact crater centered at 21.7°N 8.1°W and showing a depth of 3.6 km below MOLA datum. A light-toned layered deposit (LTD) is located on the southern part of the crater floor. It extends roughly 1000 km² and shows a thickness of up to 1 km.

LTDs are found in many impact craters in Arabia Terra and are commonly associated with formation processes that require interaction with liquid water. Therefore, they are of great importance in the search for life and habitable conditions on Mars. However, the nature of these deposits is not yet well constrained and there are multiple different theories of the processes involved in their formation, including volcanic [1], lacustrine [2, 3], ground-water-related [4], spring mound [5], mud volcanism [6], salt diapirism [7] and aeolian airfall [8, 9]. Understanding and identifying the processes responsible for the formation of LTDs can give us a better insight into the geologic history of Mars and its climatic evolution. The timescales on which these processes were active allow us to determine environments where liquid water was available over long periods of time and which, therefore, were capable of sustaining conditions favourable to early life.

Geologic Setting and Study Area: Becquerel crater is located in western Arabia Terra, a Noachian-aged region near the dichotomy boundary between the southern highlands and the northern lowlands. Arabia Terra is a region of increased hydration, as observed by the Mars Odyssey neutron spectrometer [10]. Hydrologic models indicate that Arabia Terra could have been a region of enhanced ground water upwelling in early Mars history [4].

Data and Methods: CTX image data was used as basis for mapping. Image processing and mosaicing was conducted in ISIS3 environment and mapping was carried out in ESRI's ArcGis 10.5. HRSC and HiRISE data were used to gain additional information about the surrounding area of Becquerel crater, surface texture and topography. CRISM data was used to investigate the surface mineralogy.

Observations: 21 stratigraphic units have been identified in the mapping of Becquerel crater. Becquerel crater is surrounded by Noachian-aged plains [11]. Due to its ancient age, most of the crater rim is heavily eroded. The inner crater rim is incised by numerous small channels that terminate on the crater floor. Three channels end in delta-like deposits. The crater floor contains large areas of pitted material as well as smooth and hummocky materials. In addition to a pitted and smooth surface, there are also grooved and polygonally ridged materials present next to the layered deposit. On the northeastern crater floor, in the lowest portions of Becquerel crater, lies the LTD which consists of alternating light and dark layers. The LTD has a very high albedo, faults and fractures and only very few craters can be found on its surface. The North and South edges of the deposit are partially covered by dark dunes, which are also found on terraces between layer couplets. In the southeastern portion of the LTD, the surface is covered by yardangs. On the floor of the 50 km large unnamed crater inside Becquerel, tilted and layered blocks of bedrock, surrounded by predominantly pitted material can be found. A large, dark barchan dune field lies on the southwestern edge of the 50 km crater.

Preliminary Results and Discussion: The surface of the LTD in Becquerel crater appears young, displaying only very few impact carters. The presence of nearby dunes and yardangs on the LTD suggest ongoing erosion by wind. This indicates that the original size of the deposit may have been much more extensive, even covering the whole crater floor [4]. The processes involved in the formation of the LTDs in Becquerel and elsewhere in Arabia Terra must have been capable of transporting and depositing large amounts of sediment, and must have been active over long periods of time.

However, no signs of volcanic activity were found in the area of Becquerel crater. The closest proposed volcanic province, Eden Patera [1], is more than 600km to the North, and is therefore unlikely to have created 100s of meters of layered strata in Becquerel [12]. No evidence was found for valley networks or inlets in and around the crater. If the sediment was transported by flowing water, then the transport paths are either buried or eroded [12]. A small number of isolated conical structures have been found inside Becquerel crater, presumably too few to support the theory of LTD formation by mud volcanism. The inner crater wall of Becquerel crater is incised by numerous small channels that could possibly be remnants of ancient groundwater discharge. Based on the mapping results, the most likely depositional mechanism is subaerial deposition and interaction with groundwater. The observed layered strata of the LTD mound could be explained by orbital forcing, as proposed by [9].

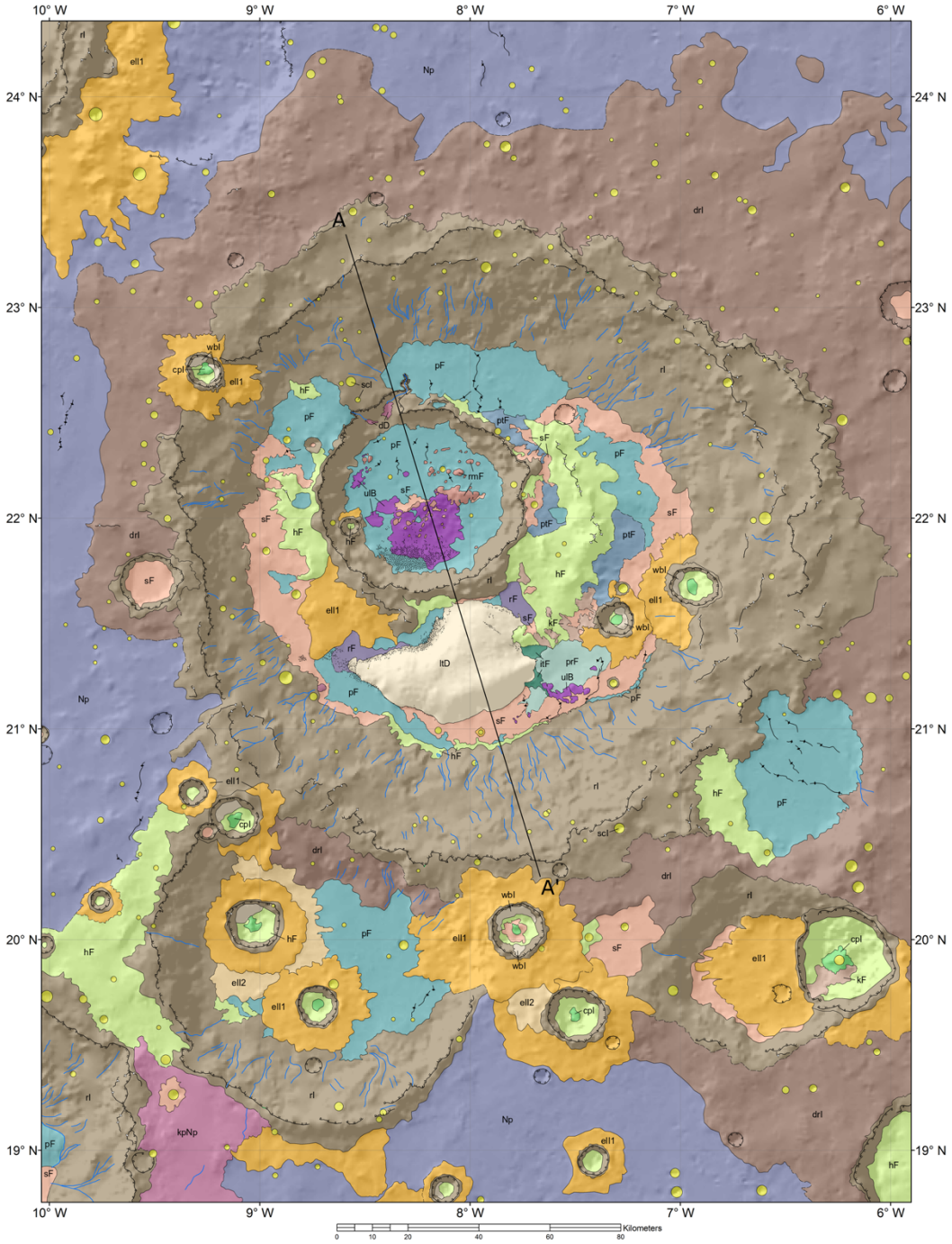

Fig. 1. Morphologic map of Becquerel crater.

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