THE BATHYMETRY OF MORAY SINUS AT KRAKEN MARE. V. Poggiali[1], M. Mastrogiuseppe[2] and A. G. Hayes[1], [1]Cornell Center for Astrophysics and Planetary Science, Cornell University, 104 Space Sciences Building, 14853 Ithaca, New York, USA (vpoggiali@astro.cornell.edu), [2]Division of Geological and Planetary Sciences, California Institute of Technology, USA.

Introduction: During the fly-by T104 of Titan (August 21st, 2014), the Cassini spacecraft pointed its antenna at nadir to observe in radar altimetry mode Kraken Mare, the largest of the three seas currently standing on the Northern polar area of Saturn's largest moon (see upper-left panel of Figure 1).

The Cassini RADAR is an instrument able to work in different modes: imaging, altimetry, scatterometry and radiometry [1]. These modes have been activated sequentially during each of the 127 Titan fly-bys that Cassini performed during its 13 years long tour of the saturnian system (2004-2017).

The analysis of the radar echoes received during the fly-by T91 (May 23th, 2013) from the seafloor of Ligeia mare resulted in a maximum depth of about 180 m along the spacecraft ground track [2] and in a best fit composition of the liquid (volume fraction) of 71% CH_4, 12% C_2H_6, and 17% N_2 [3].

Punga mare was observed during the flyby T108 (January 11th, 2015) and resulted in a maximum depth along the altimetric track of about 110 m with a composition of the liquid avoided of the presence of

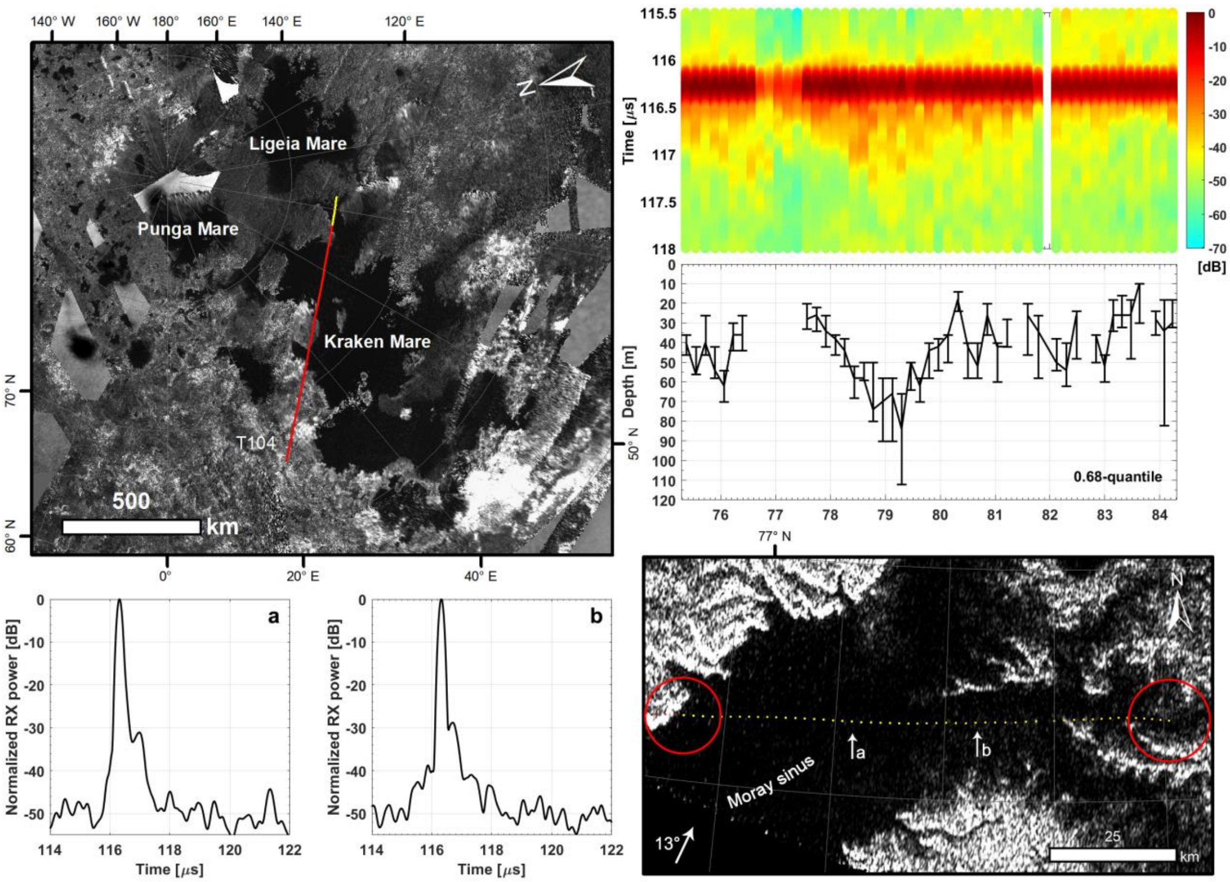

Figure1. (upper-left) SAR mosaic of the northern polar area of Titan, with the T104 flyby ground track highlighted in red and yellow. With the yellow line we indicated the portion of the track over the Moray sinus. (lower-left) Two echoes identified by the burst-IDs 261040117 (a) and -43 (b) are shown here with their location indicated in the lower-right panel, where a closer view of the Moray sinus is shown (SAR image: T28). Therein, the actual dimension of the 3dB antenna footprints is indicated with red circles. Note the peculiar morphology of the area, where a rugged coastline and number of islands are present. (upper-right) radargram of the Moray sinus obtained after the application of the super-resolution processing. Reflections from a shallow seafloor are evident and lead to the bathymetry shown in the central-right panel with the associated 1σ error.

ethane (80% CH_4, 20% N_2) [4].

Herein, we present the results obtained from the analysis of data acquired during the flyby T104, during which the Cassini radar observed Kraken mare.

Kraken mare seafloor detection: We processed the flyby T104 altimetric data with the available standard processing routines [5] and we noticed that, while no evidence of seafloor echoes is present from the observed western and central portions of the sea, in the eastern one shallow subsurface reflections have been received (see lower-left panel of Figure 1). The latter area is a bay of the Kraken mare that has been named Moray sinus by the International Astronomical Union (IAU) and has been previously identified as an estuary-like morphologic feature [6].

First, we produced the radargram shown in the upper-right panel of Figure 1 by applying super-resolution techniques able to improve the seafloor detection capabilities of the radar altimeter, as described in [7].

Estimation method: In order to obtain seafloor depths with the relative estimation errors, we compiled a lookup table of simulated radar echoes dealing with an 'a priori' uniform probability distribution covering the widest possible range of values for the three parameters: depth of the sea (D), surface vs seafloor echo power ratio (Ps/Pss) and seafloor roughness (σ_r). Previous studies demonstrated that the description of the seafloor radar echo by means of these three parameter is able to effectively describe the echo received by the seafloor [4]. Thus, for D we chose a range from 10 to 250 m (2 m step), for Ps/Pss we explored a range from 10 to 45 dB (1 dB step) and for σ_r we we went from 0 to 44 m (2 m step) resulting in a total number of ~100k combinations of the model parameters, each composed of 400 Monte Carlo realizations. After fitting the simulated waveforms over the received ones by means of least-square estimations, we produced "a posteriori" probability density functions from which we extracted triplets of best fit model parameters associated to each of the received seafloor echoes.

Preliminary results: The middle-right panel of Figure 1 shows the bathymetry resulting from our estimations, with errors for each individual radar observation that are mainly dependent on the Signal-to-Noise Ratio of the seafloor echo and roughness.

The resulting maximum depth at the Moray sinus of Kraken mare, recorded along the flyby T104 altimetric track, is of ~80 m.

We note the presence at the seafloor of a ~60 m deep concave basin extending from 78° to 80° E in longitude at the center of the bay followed by an eastward seafloor positive slope of 2.3 (±0.02) mdeg from 80° to 84° E.

The bathymetry shows some gaps: (1) at ~77° E longitude an anomalous decrease of surface power could be associated to a local increase in the sea surface roughness (at this regard, further investigations are in progress); (2) three footprints (81.40°, 82.66 and 83.78° E) are associated with seafloor echoes that cannot be resolved because of the extremely shallowness of the sea at those locations (<~15/20 m). In particular, the second and third of these footprints have been acquired close to a couple of islands.

Future work: An estimation of the value of the loss tangent of the liquid medium is being carried out by evaluating the amount of radio attenuation of the signal from the seafloor as a function of the variation of the depth.

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