



Comparing Doublet Craters on Vesta and Ceres to Investigate Binary Asteroid Differences Between Inner and Intermediate Zones of the Main Belt



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TL;DR

- Doublets = binary asteroid impacts
- Vesta doublets match other observations
- Ceres doublets < Vesta doublets
- Why?

What are Doublet Craters?

A pair of nearby impact craters created during the same primary impact event [1]. Doublets are observed on: Earth, Moon, Mercury, Venus, Mars, and Ceres [2,3,4,5,6,7,8,13], and now on Vesta.

It is believed that doublet craters are formed by the impact of well-separated binary asteroids [9].

This Study

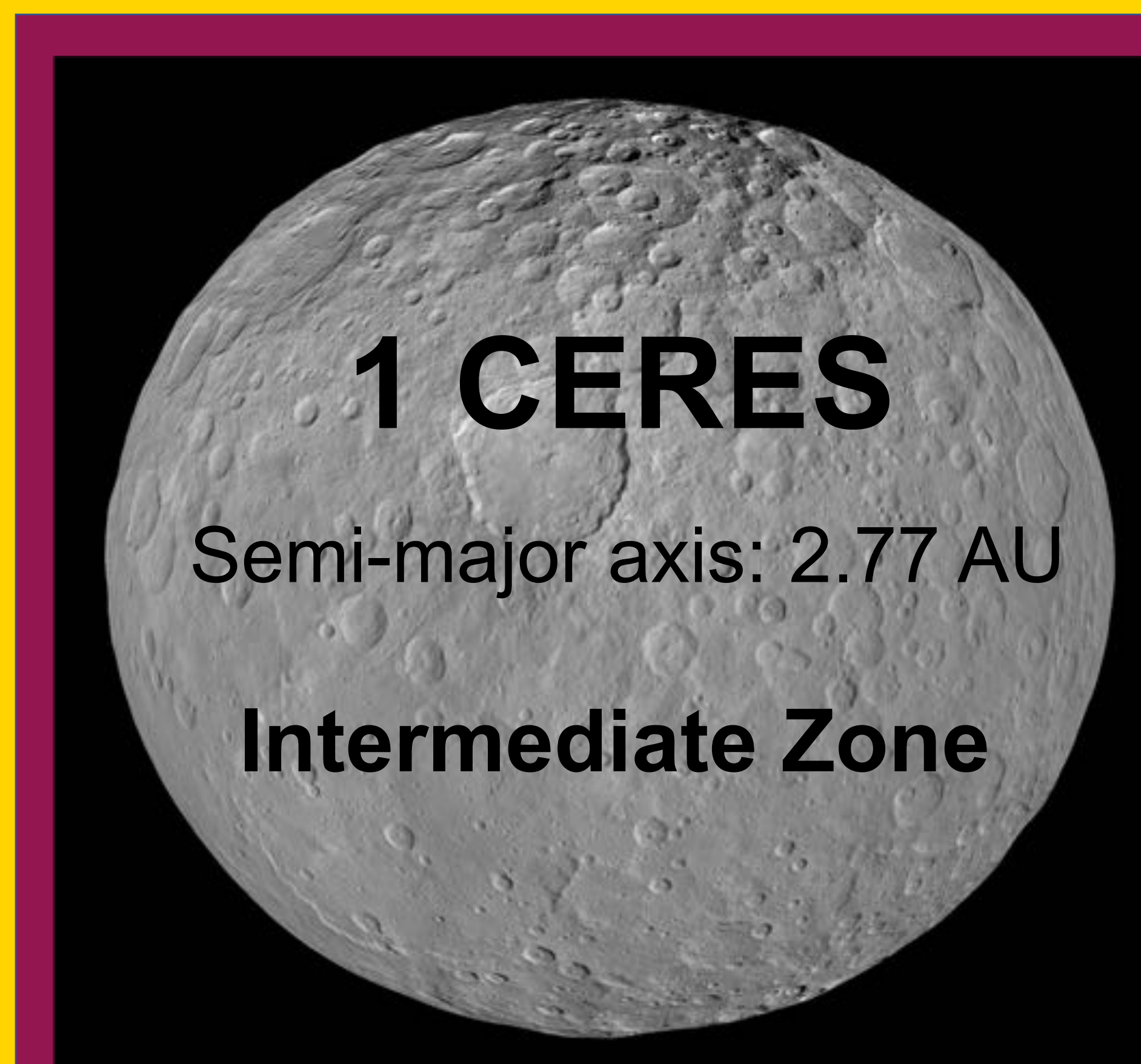
Using an approach we applied in an earlier study involving Ceres [13], we used Framing Camera images from the Dawn spacecraft [10] to search for doublet craters on 4 Vesta formed by impactors < 1 km.

Crater pairs are considered doublets based on the following criteria:

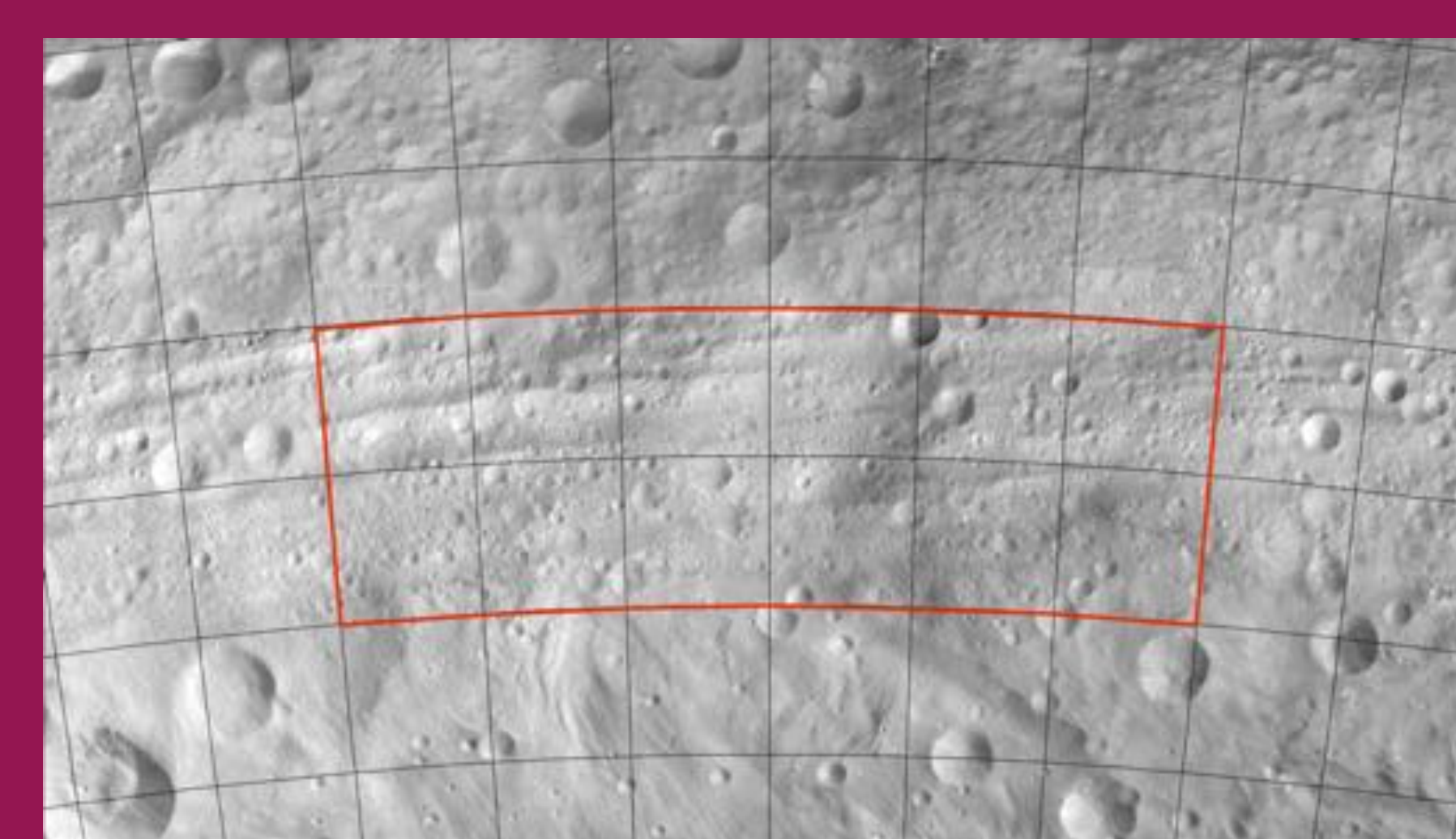
- similar erosion
- presence of a septum
- presence of ejecta lobes

Crater counting and crater pair analysis

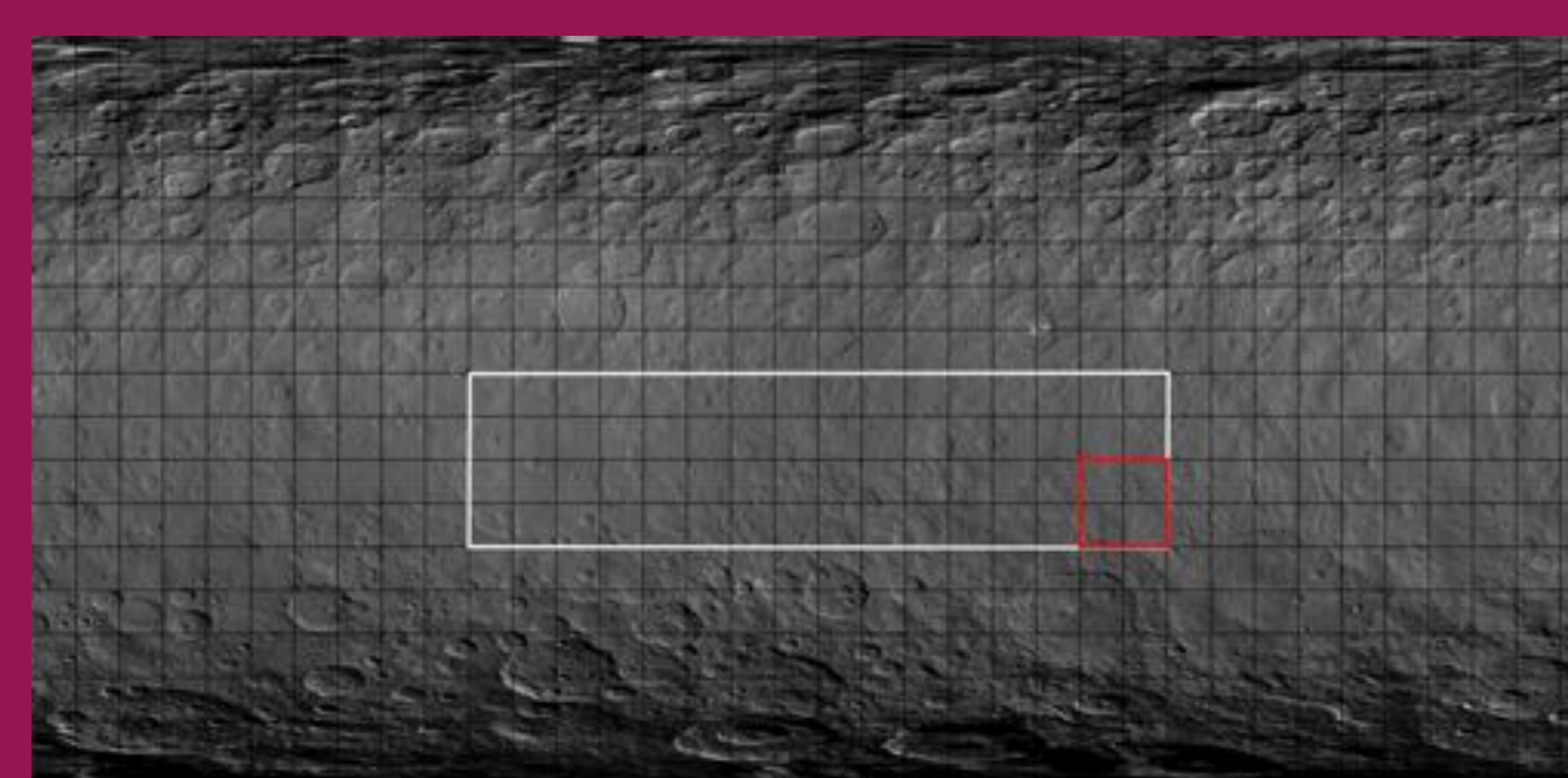
Target Body



Survey

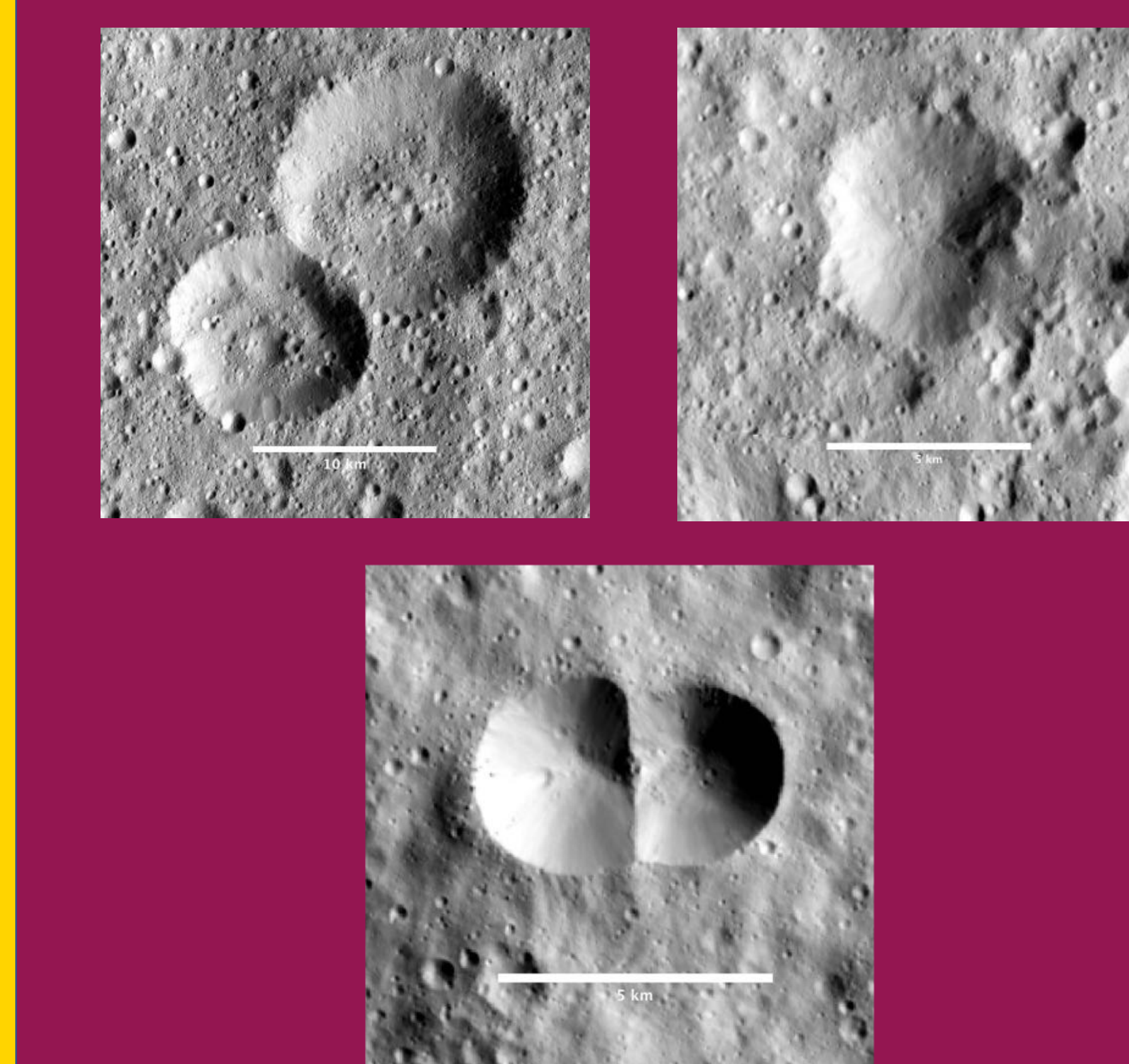


- 25,000 km² study area
- 148 craters ≥ 3 km
- 528 pairs separated by <20 km
- 3 likely doublet craters



- 430,000 km² study area
- 1084 craters ≥ 3 km
- 2087 pairs separated by < 20km
- 7 likely doublet craters [13]

Example Doublets



Results

- 2.1% of impact events on Vesta in study area are binary impacts
- Indicates 14% of Inner Zone asteroids < 1 km in diameter are binary systems (radar and photometric studies show ~15% of all NEAs and MBAs are binaries [2, 12]).

- 0.7% of impact events on Ceres in study area are binary impacts [13]
- Indicates only 4.6% of Intermediate Zone asteroids < 1 km in diameter are binary systems.

was done using JMARS [11].

Crater pairs are excluded for:

- superposition
- differing depth

Crater scaling law applied to estimate max crater size for 1 km impactor [14].

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