SPIRAL FEATURES AND THE CORIOLIS EFFECT ON VESTA’S BASIN RHEASILVIA. K. Otto¹, R. Jaumann¹,², K. Krohn¹, K.-D. Matz¹, F. Preusker¹, T. Roatsch¹, F. Scholten¹, I. Simon¹, K. Stephan¹, C. A. Raymond³ and C. T. Russell⁴, ¹Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institute of Planetary Research, Germany (Rutherfordstraße 2, 12489 Berlin, (katharina.otto@dlr.de), ²Institute of Geosciences, Freie Universität Berlin, Germany, ³California Institute of Technology, Jet Propulsion Laboratory, Pasadena, USA, ⁴Institute of Geophysics and Planetary Physics, University of California, Los Angeles, USA.

Introduction: The Dawn space craft orbited asteroid Vesta for one year arriving in August 2011 [1]. The on-board Framing Camera (FC) collected image data with a resolution up to 20 m/pixel [2]. Stereo images from the High Altitude Mapping Orbit (HAMO, 60 m/pixel) were used to construct a Digital Terrain Model (DTM) of Vesta’s surface [3].

The FC images and the DTM revealed a large impact basin in the southern hemisphere, named Rheasilvia. Rheasilvia’s central peak located at 75°S and 301°E nearly coincides with Vesta’s south pole. Its diameter of about 500 km has the dimension of Vesta’s diameter (525 km) [2, 4]. This and Vesta’s relatively short rotation period of 5.3 hours indicate that the Coriolis force is likely to have an effect on mass motions within the Rheasilvia basin [5]. Indeed, a pervasive spiral deformation pattern has been observed [6].

The Coriolis Effect: The Coriolis force is a fictional force associated with rotating systems. The rotation deflects the motion perpendicular to the rotation axis to cause curved trajectories. The Coriolis force $F_C$ is given by

$$F_C = -2m\Omega \times \vec{v}$$

where $m$ is the mass of the moving body, $\Omega$ the angular velocity of the rotating body and $\vec{v}$ the velocity of the moving object. The trajectory of a mass moving in the horizontal plane on a rotating sphere is described by a circle with inertial radius $R$. The inertial radius is dependent on the magnitude of the velocity $v$, the latitude $\phi$ and the magnitude of the angular velocity $\Omega$. It is given by

$$R = \frac{|\vec{v}|}{2|\Omega| \sin \phi}.$$  

Figure 1: Spiral pattern in Vesta’s southern hemisphere. Shown is a stereographic projection (equal angle) on a sphere of 255 km.

Method: We mapped the most prominent curved features of the spiral deformation pattern in the Rheasilvia basin and used the data to calculate their three dimensional location. A reference spheroid of 285 km by 229 km was used to approximate Vesta’s shape and to determine the three dimensional location. At each point along a curved feature we approximated a circle and determined the inertial radius $R$. Knowing the angular velocity $\Omega$, the latitude $\phi$ and the inertial radius $R$, we calculated the velocity of the motion using Eq. 3.

Results: The velocities were plotted against the DTM profile of each feature. We analysed the correlation of elevation and velocity to find implications for the mass wasting type.