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GEOMORPHOLOGY OF THE KROENKE CANYON ON THE ONTONG JAVA PLATEAU

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BACKGROUND

Submerged in the clear blue waters northeast of the Solomon Islands is the Ontong Java Plateau; this massive submarine platform spans an approximate 1,500,000 km², roughly the size of Sudan or 18 U.S. southeast states (Fig. 1b). The composition of the OJP is carbonate rock with accompanying interbedded chert layers. Southwest of the Nauru Basin on the OJP, a canyon is visible – the Kroenke Canyon. Similar to the plateau, this canyon is also massive in size and length. Kroenke Canyon is one of the world’s largest submarine canyons currently documented. It is unique, or mysterious as some might say, because of the canyon’s unknown history and formation.

METHODS

- Multibeam data were collected by the Schmidt Ocean Institute using the R/V Falkor’s Kongsberg EM302 and EM307 transducers in October 2014.
- CARIS HIPS and SIPS 9.0 was used for data post-processing.
- CUBE BASE surfaces were created at 62 m resolution with a 42 m resolution overlay.
- Contour surface was created for depths between 2700 and 4000 m with an interval of 100 m (Fig. 2a).
- Along axis, 3-D profiles were created of the Kroenke Canyon thalweg (Fig. 2b).
- 3-D profiles (A-J) were created at every 100 m contour from 3100 to 4000 m depth (Fig. 2a, 3).
- Profiles were measured where the thalweg, the lowest connective points within a canyon, intersected a contour (Fig. 2a).
- Profiles A-J were used to measure relief and calculated the slopes at depths 300, 150, and 75 m from the thalweg east and west of the canyon (Fig. 3).
- A slope map was used to enhance terraced features along canyon walls.

TABLE 2

<table>
<thead>
<tr>
<th>Distance (m)</th>
<th>VE: 25x</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>25x</td>
</tr>
<tr>
<td>310</td>
<td>25x</td>
</tr>
<tr>
<td>320</td>
<td>25x</td>
</tr>
<tr>
<td>330</td>
<td>25x</td>
</tr>
</tbody>
</table>

Depth measurements were taken at 300, 150, and 75 m above the thalweg. At these depths the width was measured from the west to east sides of the canyon where the width intercepted the canyon walls.

TABLE 3

<table>
<thead>
<tr>
<th>West End</th>
<th>East End</th>
<th>West Slope</th>
<th>East Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>150</td>
<td>0.120</td>
<td>0.060</td>
</tr>
<tr>
<td>310</td>
<td>145</td>
<td>0.110</td>
<td>0.050</td>
</tr>
<tr>
<td>320</td>
<td>140</td>
<td>0.100</td>
<td>0.040</td>
</tr>
</tbody>
</table>

West and east slopes were calculated by dividing depth intervals of 150 or 75 m by the difference of horizontal point distances.

REFERENCES


ACKNOWLEDGEMENTS

Special thanks to CAFES for Academic Partnership, Schmidt Ocean Institute and the crew of the R/V Falkor for data collection, College of Charleston Department of Geology and Environmental Geosciences, College of Charleston School of Science and Math, and the College of Charleston BEAMS Program.

RESULTS

- Depths within the mid-northern region of the canyon range between 2,300 and 4,200 m.
- Canyons converge at 2 profiles, A’-A’ and F-F’ through J’J’ (Fig. 2a).
- Throughout profiles A’-A’ to J’J’, the canyon channel appears to have a U-type shape, where the bottom is flat and the canyon walls are vertical (Fig. 3).
- The average slopes for the west and east sides of the canyon show they are not the same (Fig. 4).
- The widths measured 300, 150, and 75 m from the thalweg for each profile.

FIGURE 2

Contour map with an interval of 100 m. Along axis profile (K-K) intersects contours in 10 locations between 3,100 and 4,000 meters depth. Canyon profiles A’-A’ were taken perpendicular to the thalweg.

FIGURE 3

Profiles A-J aligned with the Kroenke Canyon thalweg. Profile depths range from 3,200 to 4,000 m.

FIGURE 4

The slope within Kroenke Canyon varies significantly. Towards the outer edges of the canyon and at the canyon’s base the gradient is low whereas the canyon walls have a much higher gradient (see inset).

FIGURE 5

West vs East Average Slopes

- Depths within the mid-northern region of the canyon range between 2,300 and 4,200 m.
- Canyons converge at 2 profiles, A’-A’ and F-F’ through J’J’ (Fig. 2a).
- Throughout profiles A’-A’ to J’J’, the canyon channel appears to have a U-type shape, where the bottom is flat and the canyon walls are vertical (Fig. 3).
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- The widths measured 300, 150, and 75 m from the thalweg for each profile.

ABSTRACT

Little is known about the Kroenke Canyon, which is located in the Ontong Java Plateau (OJP), situated between the Solomon Islands and the Federated States of Micronesia in the southwest Equatorial Pacific. The massive submarine platform of the Ontong Java Plateau is composed of carbonate rock layers; accompanying interbedded chert. To better understand its Kroenke Canyon, multibeam data were collected in late 2014 by Schmidt Ocean Institute on R/V Falkor using Kongsberg EM302 and EM307 transducers. The observed area is in the northern region of the Kroenke Canyon, where depths range between 3,100 to 4,000 m. Data were post-processed using HIPS and SIPS 9.0 to create 3-D bathymetric profiles, advancing knowledge about the canyon’s geomorphology and substrate character. The mystery behind the origin of the Kroenke Canyon is still left unsolved; however, research and analysis enabled the characterization and shape of Kroenke Canyon as unusually broad and flat with terraced walls, providing another clue to its creation.

DISCUSSION

As noted by Schmidt Ocean Institute, there has been minimal exploration in the Kroenke Canyon due to limited resources and the canyon’s remote location. As a result, scarce research limited the focus of this study to characterization of the geomorphology of the canyon. Slopes of the canyon’s west and east channel walls were compared (Fig. 5a) in order to better classify the symmetry of the canyon. The greater the slope difference between the walls suggest a more asymmetric canyon shape. The thalweg in Profile C-C’ (Fig. 3) is relatively centered within the canyon; thus the average slopes of C-C’ are fairly similar (Fig. 5b). Alternatively, Profile D-D’ (Fig. 3) shows an asymmetrical canyon where the slope average differences are much greater (Fig. 5a).

The width evolution in the Kroenke Canyon entertains different canyon features. Measurements that used consistent depths of 300, 150, and 75 m above the thalweg allowed for consistent width measurements for each profile. The width variance between 300 and 150m in Profile A-A’ (Fig. 5b) is significant. However, the reality of this width distance is the convergence of canyons seen in Figure 2a. The width measurement for Profile A-A’ at 150 m from the thalweg intercepts a peak within the Canyon (Fig. 3).

Presently, the origin of the Kroenke Canyon is still not understood; however, this research and analysis reveals an unusually terraced canyon with broad and flat characteristics. Questions still remain. Could one of world’s most massive volcanic events have taken place on the OJP, with the terraced canyon walls revealing remnants of lava flows? This study provides new insight and raises further questions -- setting the stage for future investigations.