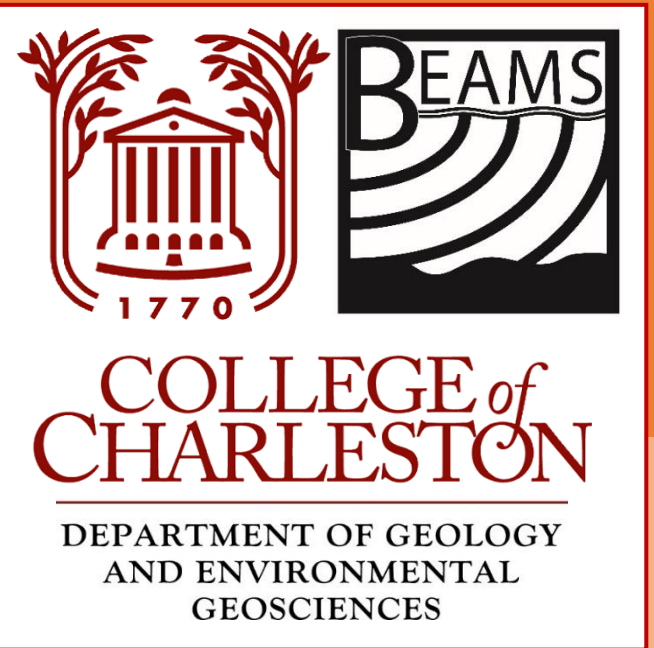




GEOMORPHOLOGY OF THE KROENKE CANYON ON THE ONTONG JAVA PLATEAU

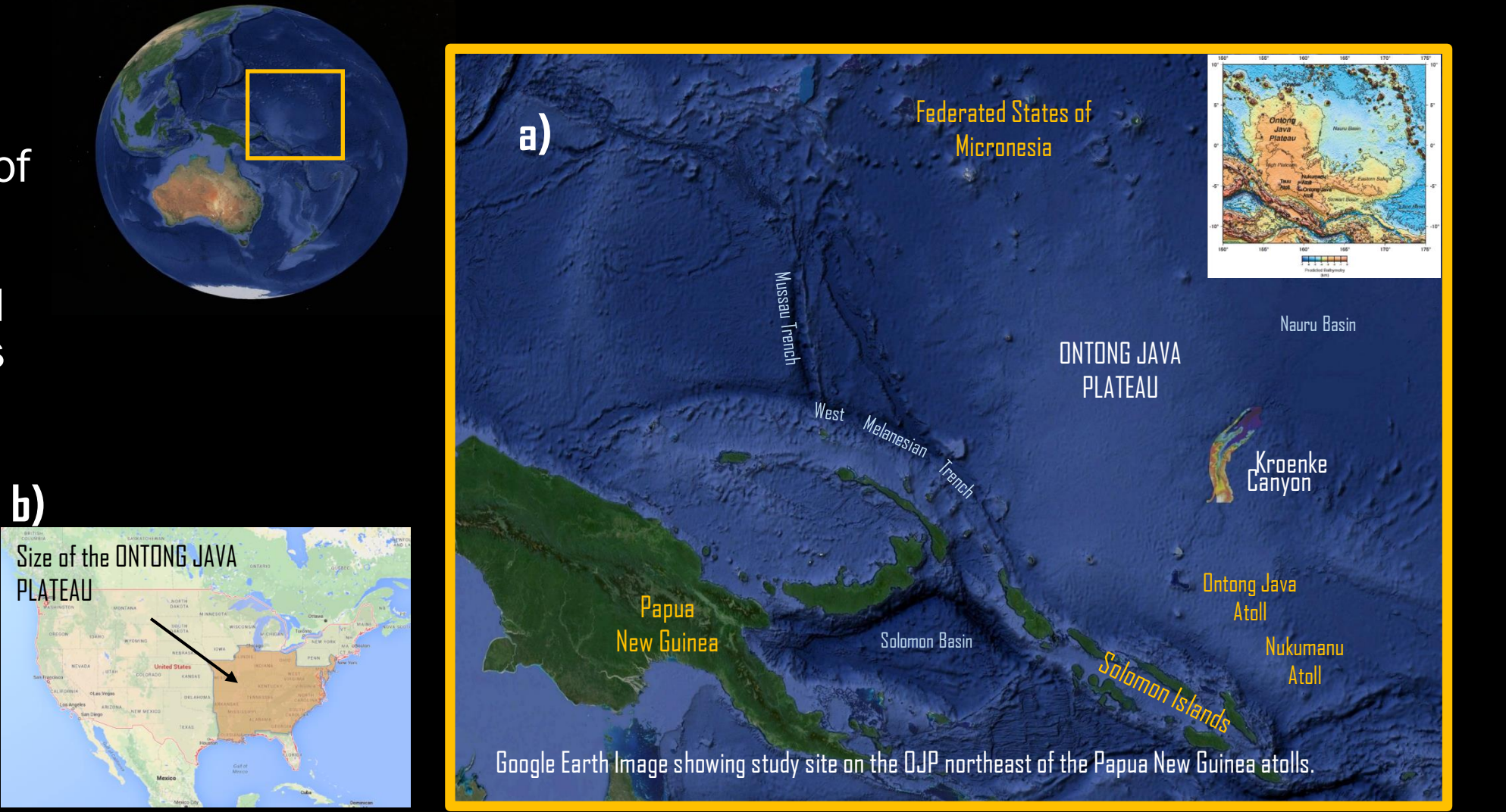
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STUDY SITE

FIGURE 1

- Google Earth image of Kroenke Canyon on the OJP between the Solomon Islands and the Federated States of Micronesia in the southwest Equatorial Pacific.
- The OJP spans 18 US states.



BACKGROUND

Submerged in the clear blue waters northeast of the Solomon Islands is the Ontong Java Plateau, this massive submarine platform spans an approximate 1,900,000 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. Generally, submarine canyons can be traced back to old rivers flowing into the sea, also known as terrestrially derived, or from turbidity currents. Turbidity currents can take place off the continental margin, where an underwater landslide takes place. Kroenke Canyon, however, cannot be so simply classified.

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.

DATA COLLECTION

TABLE 2

Profile	Depth at				West Distance Point at				East Distance Point at			
	300 m*	150 m*	75 m*	Thalweg	300 m*	150 m*	75 m*	Thalweg	300 m*	150 m*	75 m*	Thalweg
A - A'	2800	2950	3025	3100	9000	11125	15125	18875	42375	24875	24375	18875
B - B'	2900	3050	3125	3200	14500	17875	19000	25625	29125	27875	27500	25625
C - C'	3000	3150	3225	3300	16625	21375	21750	24375	30625	29250	28375	24375
D - D'	3100	3250	3325	3400	22000	26625	26625	30750	35000	34500	34125	30750
E - E'	3200	3350	3425	3500	24875	29375	29375	33125	37125	35625	35000	33125
F - F'	3300	3450	3525	3600	29875	34875	35000	41750	50125	46625	46375	41750
G - G'	3400	3550	3625	3700	32625	34250	35750	41375	48375	45500	44000	41375
H - H'	3500	3650	3725	3800	32250	33375	33500	42750	55125	53750	52500	42750
I - I'	3600	3750	3825	3900	38000	39125	40375	43375	51250	48000	46500	43375
J - J'	3700	3850	3925	4000	43875	44875	45875	48875	56875	53625	53625	48875

Depths measured 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

Profile	West Slope between (m)				East Slope between			
	300-150 m*	150-75 m*	75 m*- Thalweg	Average West Slope	300-150 m*	150-75 m*	75 m*- thalweg	Average East Slope
A - A'	0.071	0.019	0.020	0.036	0.009	0.193	0.014	0.057
B - B'	0.044	0.067	0.011	0.041	0.120	0.200	0.040	0.126
C - C'	0.032	0.200	0.029	0.087	0.109	0.086	0.019	0.071
D - D'	0.300	0.400	0.029	0.300	0.300	0.200	0.022	0.174
E - E'	0.043	0.400	0.013	0.219	0.100	0.120	0.040	0.081
F - F'	0.030	0.600	0.011	0.214	0.043	0.300	0.016	0.120
G - G'	0.092	0.030	0.013	0.052	0.052	0.030	0.029	0.044
H - H'	0.133	0.600	0.008	0.247	0.109	0.040	0.008	0.059
I - I'	0.133	0.040	0.025	0.073	0.046	0.030	0.024	0.040
J - J'	0.400	0.004	0.018	0.207	0.041	0.036	0.027	0.038

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

* Above the thalweg

REFERENCES

Mann, P., and Asahiko, T., 2004, Global tectonic significance of the Solomon Islands and Ontong Java Plateau convergent zone: *Tectonophysics*, v. 389, p. 137-190. The Mysteries of Ontong Java, 2014, Schmidt Ocean Institute: <http://www.schmidt-ocean.org/story/show/2253> (accessed April 2016).

ACKNOWLEDGEMENTS

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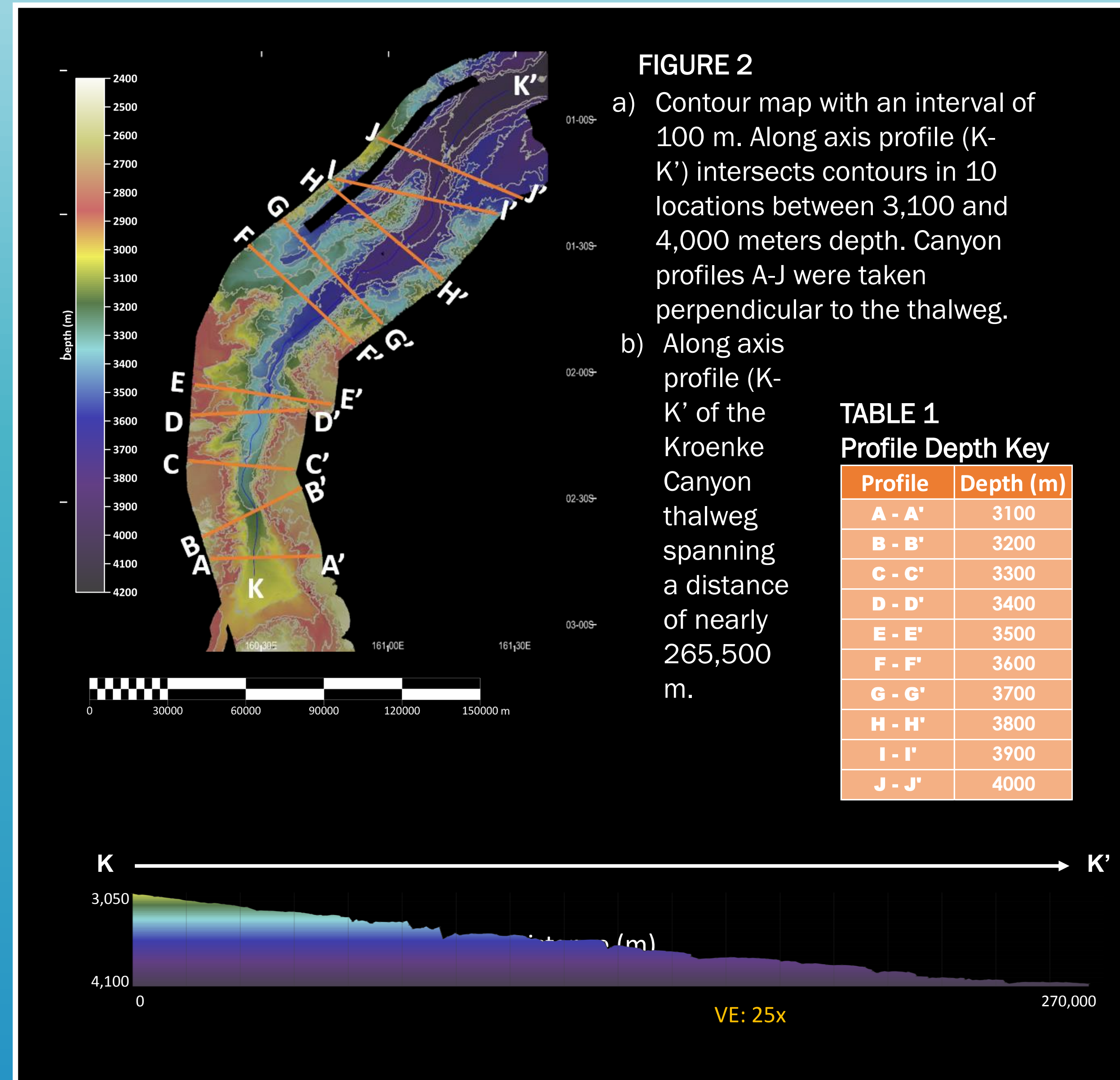


FIGURE 2

- 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-J were taken perpendicular to the thalweg.
- Along axis profile (K-K') of the Kroenke Canyon thalweg spanning a distance of nearly 265,500 m.

TABLE 1

Profile	Depth (m)
A - A'	3100
B - B'	3200
C - C'	3300
D - D'	3400
E - E'	3500
F - F'	3600
G - G'	3700
H - H'	3800
I - I'	3900
J - J'	4000

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.

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 suggests 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.

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.

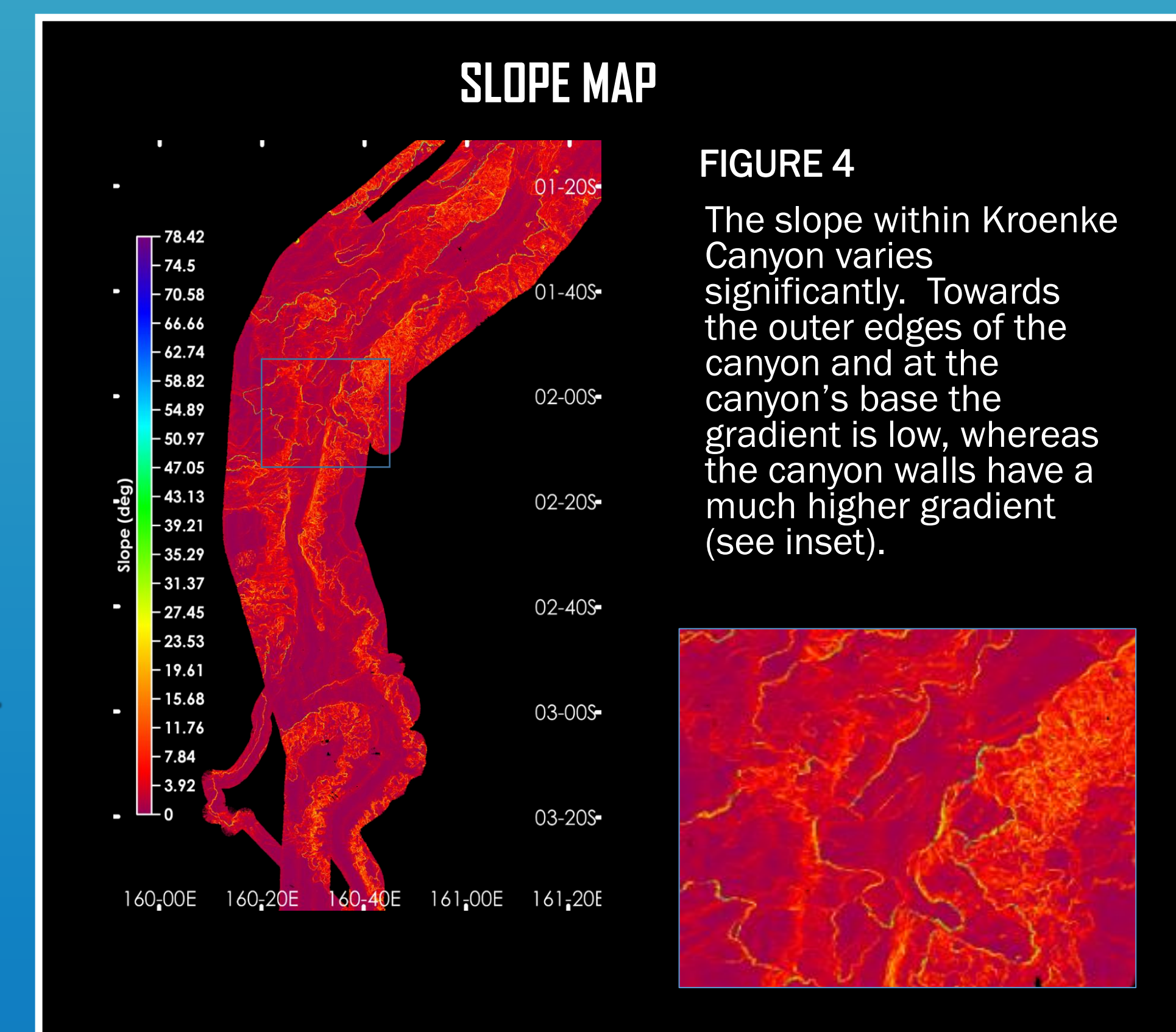
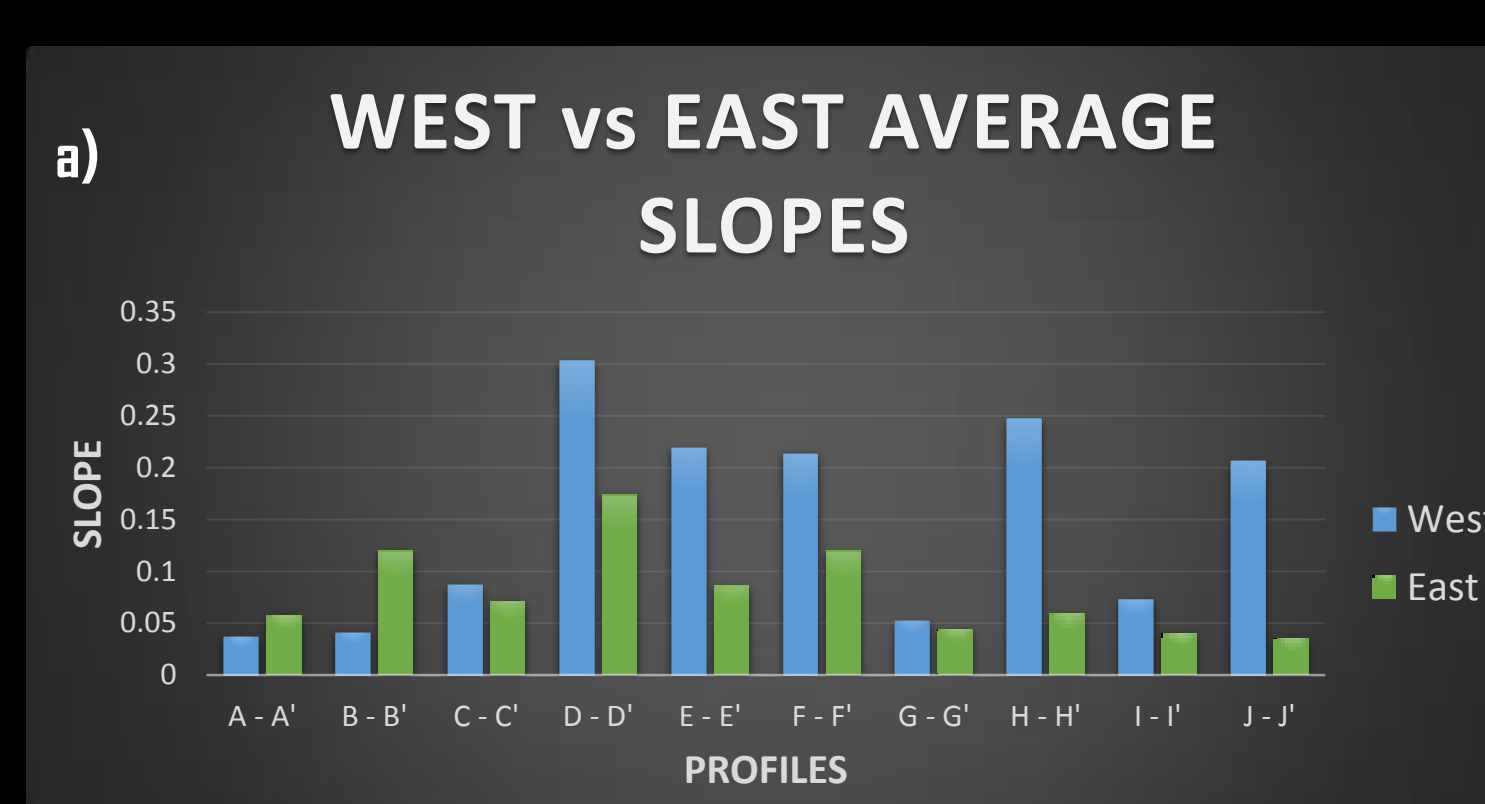


FIGURE 4

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



a) Slopes on the west and east sides of the canyon are compared to assess canyon channel symmetry with increasing depths (A-J).



b) Widths were measured at 300, 150, and 75 m above the thalweg. Differences of the widths within each profile provide information about the shape of the canyon. Small width differences suggest a more vertical canyon wall, whereas a greater width difference would suggest a lower slope.