The Relationship of Canali with Coronae, Wrinkle Ridges (WR), and Lava Flows across Henie Quadrangle (V-58), Southern Venus. J. Demorcy¹, K.J.E. Boggs¹, J. Shackman¹, J. Hall¹, M. Chowdhury¹, H. Bley¹, E. Varga¹, R. Ernst²,3, H. El Bilali²,3, E. Bethell⁴, H. Wehnes⁵, and S. Hammer⁶. ¹Department of Earth and Environmental Sciences, Mount Royal University, 4825 Mount Royal Gate se, Calgary, Alberta, Canada T3E 6K6; ²Department of Earth Sciences, Carleton University, 1125 Colonel By Drive, Ottawa, Ontario, Canada K1S 5B6; ³Faculty of Geology and Geography, Tomsk State University, 36 Lenin Avenue, Tomsk, Russia 634050; ⁴Department of Earth and Environmental Sciences, University of Ottawa, 75 Laurier Avenue E, Ottawa, Ontario, Canada K1N 6N5; ⁵Faculty of Mathematics, University Waterloo, 200 University Avenue West, Waterloo, Ontario N2L 3G1; ⁶Retired Research Scientist, Geological Survey of Canada, Ottawa, Ontario.

Introduction: Lava channels, or canali, are long, narrow features with parallel sides that cross ~25% of Venus’s surface [4; e.g. Fig. 1]. They are typically <1-3km wide and concentrated in lowland plain regions [1,2,4]. Several studies suggest these lava channels were created before topographic uplift [1,3]. The lengths and widths of canali can provide insight into the lava composition of these channels. Narrower and shorter channels have been suggested to indicate low viscosity and basaltic composition [2]. Generally, younger canali features have sharper curves and more complex patterns than older features [2]. Canali morphologies and the three-wrinkle ridge (WR) - canali relationships are illustrated in Figure 2.

Figure 1: Study area - Henie Quadrangle (V-58) southern Venus (2A). The red lines on 2B are canali segments. Coronae are outlined in blue. Segments Yc1/Yc2, and H6 emerge from a graben adjacent to the Fotla Corona. A sinuous rille channel emerges from Huang Daopo Crater. Valley network channels occur adjacent to Fotla Corona).

WRs are sinuous ridges thought to form due to compression [5,6], and diverge upslope and converge downslope [5]. Three distinct types of canali - WR relationships are illustrated in Figure 2:

i) Type A WR cut across the canali segments without interruption (canali older than WR),
ii) Type B, WR ends at the margins of the canali segment (WR older than canali), and
iii) Type C, where the canali are offset along the WR or terminated at the (ambiguous).

This study describes the detailed mapping of canali segments across the Henie Quadrangle (V-58; Fig. 1) in southern Venus.

Results and Observations:

Table 1: Curvature geometry characteristics of selected canali segments.

<table>
<thead>
<tr>
<th>Fragments</th>
<th>Average width segments (km)</th>
<th>Radius of curvature (avg in km)</th>
<th>Wavelength (avg in km)</th>
<th>Width Maxima (km)</th>
<th>Width Minima (km)</th>
<th>Average curve Angle</th>
<th>Sinuosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>2.10</td>
<td>2.59</td>
<td>45.27</td>
<td>1.02</td>
<td>0.83</td>
<td>None</td>
<td>0.02</td>
</tr>
<tr>
<td>H4a</td>
<td>1.56</td>
<td>5.15</td>
<td>39.30</td>
<td>0.64</td>
<td>0.59</td>
<td>60.00</td>
<td>0.03</td>
</tr>
<tr>
<td>H5</td>
<td>1.53</td>
<td>1.50</td>
<td>13.71</td>
<td>0.86</td>
<td>0.87</td>
<td>60.00</td>
<td>0.07</td>
</tr>
<tr>
<td>H6</td>
<td>(0.5-1.8)</td>
<td>2.77</td>
<td>12.10</td>
<td>1.62</td>
<td>0.72</td>
<td>85.00</td>
<td>0.08</td>
</tr>
<tr>
<td>H7</td>
<td>0.9-2.6</td>
<td>14.67</td>
<td>4.54</td>
<td>2.20</td>
<td>1.30</td>
<td>71.00</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Three types of WR–Canali relationships:

Figure 2: All three (left) WR-Canali relationships were observed in the study area. Segment H6 is a type B (right top) and the segment in the bottom right is a type A and C.

Figure 3: Transect profiles across canali segment H4a (blue lines) along N-SE trending WRs (red line) are not consistent. Transects CD and ER define the expected valley that is not seen in transect AB.
Discussion and conclusions:

General Canali Characteristics (Table 1): Most canali segments in this study have gentle curves suggesting that they are older [2]. These segments are mostly <2km wide, characteristic of a basaltic composition [2,3]. The meander geometry analysis of Venusian canali segments (H1, H4a, H5, H6, and H7) reveals a spectrum of sinuosity, curvature, and width variations, indicating dynamic and diverse channel characteristics. Notably, high sinuosity values in certain segments suggest pronounced meandering, which suggests complex fluid dynamics and geological processes shaped these lava channels [4].

More than one generation of canali: Canali cross-cutting relationships with the Rafara Fluctus (RF) suggest that there are at least two generations of canali (Fig. 2A, white rectangle), with segments Yc1 and Yc2 being younger than RF while H4a is older than RF. The three relationships between WRs and canali also suggest at least two generations of canali. Type A WRs cut across canali segment H4a, suggesting that the WRs are younger than H4a. While Type C WR-canali relations are ambiguous (e.g. segment H5), the canali segment that crosscuts WRs (Type B; e.g. segment H6) suggests that H6 canali segment is younger than the WRs.

Sources of canali: Three canali segments are associated with coronae (Fig. 1), suggesting a possible origin related to coronae formation from the canali.

Acknowledgement: Thank you to the International Venus Research Group for many discussions, your input, and your support. We also appreciate the PDS Magellan SAR images support team.

We greatly appreciate the PDS Magellan SAR images obtained from https://astrogeology.usgs.gov/search/?pmi-target=venus.

Future work:
More work is needed to link all canali segments to their origin. Further investigations and analyses are warranted to unravel channel formation's mechanisms and chronology, expanding our understanding of Venusian geology. We also aim to examine the relationship of canali with tesserae terrains.

References: