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Middle Miocene to Holocene tectonics, basin evolution, and paleogeography along the southern margin of the Snake River Plain in the Knoll Mountain-Ruby-East Humboldt Range region, northeastern Nevada and southcentral Idaho (Camilleri, P.A., Deibert, J.E., and Perkins, M.E.)

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A NOTE ABOUT THE PROVENANCE OF GRANITIC CLASTS IN CONGLOMERATE UNITS IN KNOLL BASIN

Many of the conglomerate units in the Humboldt Formation in Knoll basin contain granitic clasts. These clasts resemble the granitic rocks of the Contact pluton and we infer that the Contact pluton is the sole source of the clasts for several reasons. Foremost, the size of the granitic clasts, their abundance, and degree of angularity all significantly decrease with distance from the Contact pluton, which is a clear indication that the Contact pluton was the point source for these clasts. In addition, granitic clasts in conglomeratic units near the Contact pluton are up to 55 cm in diameter indicating a very proximal source, which could be only be the Contact pluton. Third, paleocurrent directions derived from fluvial sandstone units associated with the conglomerate units (Deibert and Camilleri, 2006) all point back to the location of the Contact pluton. Last, the conglomerate units only contain clasts that are similar to rock types exposed in the ranges adjacent to Knoll Basin – i.e. there appear to be no “exotic” clasts in the conglomerate units. This fact, along with the texturally-immature nature of all the clasts in the conglomerate units, indicates that the granitic clasts were derived from a nearby source (the Contact pluton) rather than a distal pluton.

We do note that other granitic intrusives are present northwest and south of Knoll basin, such as in the White Elephant Butte area and the Ruby-East Humboldt metamorphic core complex area, respectively, but several observations suggest that they are not the source of the clasts. Between the White Elephant Butte area and Knoll basin there are extensive exposures of Jarbidge Rhyolite. If the granitic clasts were derived from plutons to the northwest of Knoll basin, such as the White Elephant Butte area, we would expect to see some amount of Jarbidge Rhyolite clasts to be present with the granitic clasts, but they do not appear to be present. Consequently, because clasts of the Jarbidge Rhyolite are not present with the granitic clasts in Knoll basin, it suggests that the Contact pluton is the likely source of the clasts. The granitic intrusives in the core complex area south of Knoll Mountain are associated with foliated metamorphic rocks, including distinctive mylonitic and non-mylonitic schist, marble, gneiss, and quartzite. However, no clasts of such regional metamorphic rocks are present in Knoll basin. Moreover, the southward paleocurrents preclude a southern source of the granitic clasts. In summary, we infer that the sole or principal source of granitic clasts is the Contact pluton.
CORRELATION OF UNITS OF THE COUGAR POINT TUFF

Two units of the Cougar Point Tuff in Knoll basin, Cougar Point Tuff XI and Cougar Point Tuff XIII, have been correlated with large volume ignimbrites present to the northwest and northeast of Knoll Basin. It is important to note these correlations because of significant geochemical and radiometric dating studies that have been recently completed on these units. However, the new radiometric dates are not significantly different than those indicated in Table 2.

The Cougar Point Tuff XI has been correlated with the Black Canyon Member (11.667 ± 0.017 Ma) of the Rogerson Formation (Knott et al., 2016b), and the Brown’s Bench 5 unit (11.42 ± 0.08 Ma (Ellis et al., 2012), both present in the Rogerson Graben area along the Idaho-Nevada border.

The Cougar Point Tuff XIII has been correlated with the Jackpot Member (10.960 ± 0.009 Ma) of the Rogerson Formation (Knott et al., 2016b) and the Brown’s Bench 7 unit (11.05 ± 0.07 Ma) (Ellis et al., 2012) in the Rogerson Graben area, and also with the Big Bluff Member (10.952 ± 0.010 Ma) of the Cassia Formation in Cassia Hills area in southern Idaho (Knott et al., 2016a).
STREAM CAPTURE AND WESTWARD MIGRATION OF THE SNAKE RIVER-GREAT SALT LAKE DRAINAGE DIVIDE IN THE SOUTHERN END OF KNOLL BASIN

The Knoll Mountain region contains part of the drainage divide that separates the Great Salt Lake drainage basin on the east from the Snake River drainage basin on the west (Fig. DR1). In this area, the Snake River drainage system contains a north-trending and -flowing trunk stream. The trunk stream for the Great Salt Lake drainage system is Thousand Springs Creek, which flows north in its headwaters and then abruptly bends and follows an easterly course (Fig. DR1). The drainage divide between these two systems largely trends NNE along the crest of the Knoll Mountain horst, except at the southern end of the horst where it makes a sharp westward bend. We attribute the bend in the divide to headward erosion of the Salt Lake drainage system resulting in localized westward migration of the divide accompanied by capture of streams that formerly drained into the Snake River drainage basin. The capture and integration of streams during divide migration ultimately produced the sharp bend in Thousand Springs Creek (labeled EC in Fig. DR1). The evidence for westward migration of the divide and capture of streams are 1) pronounced elbows of capture along Thousand Springs Creek, 2) wind gap(s) along the modern divide, and 3) a higher trunk-stream gradient for the Great Salt Lake drainage, in comparison to the Snake River drainage system (Fig. DR1), which would result in westward migration of the divide. The aforementioned features are typical of stream capture (e.g., Bishop, 1995).

Figure DR1 shows the location of the modern drainage divide, and some of the wind gaps, streams, and sharp bends in streams that we infer to be elbows of capture. We infer that 1) the north-trending segment of Thousand Springs Creek (labeled “captured segment” in Fig. DR1) once flowed northward through a nearby wind gap on the modern divide, and 2) that it was part of the trunk stream for the Snake River drainage in Knoll basin until it was captured by the Thousand Springs Creek of the Salt Lake drainage system. Figure DR2 illustrates the inferred drainage configuration in Knoll basin prior to capture of Thousand Springs Creek in the southern end of the basin. Figure DR3 is a larger-scale shaded relief map that shows how the captured segment of Thousand Springs Creek projects into the wind gap on the modern divide and how it was probably linked to the north-flowing Snake River drainage system (c.f. Fig. DR1 and DR3). In addition, two of the NE-trending tributaries that join the captured segment of Thousand Springs Creek make sharp bends to the SE where they join Thousand Springs Creek; we interpret these bends as elbows of capture and infer that these streams originally were tributaries of the Snake River drainage trunk stream (see Fig. DR3), which is supported by the observation that their original NE trends matches those of other tributaries to the north of the divide.
In summary, we infer that the drainage divide once had a NNE trend, but with headward erosion of Salt Lake drainages, the southern end of the divide migrated to the west and captured the upper reaches of the trunk stream for the Snake River drainage system, ultimately producing the sharp bend in Thousand Springs Creek.
Figure DR1. Map showing modern streams and drainage divide in the Knoll Mountain region. EC = location of bends in Thousand Springs Creek and tributaries that define elbows of capture. Map from USGS 1:1,000,000 scale Wells and Jackpot topographic maps.
Footwall uplift along the Summer Camp intrabasin fault

Drainage divide separating part of the Salt Lake drainage basin on the east from the Snake River drainage basin on the west

Knoll Mtn horst

Granite Range

northern Snake Mountains

Miocene Knoll basin

Miocene Thousand Springs basin

Thousand Springs Creek (drains to Great Salt Lake)

Salmon Falls Creek (drains to Snake River)

Drainage divide separating part of the Salt Lake drainage basin on the east from the Snake River drainage basin on the west

Figure DR2. Map showing inferred drainage divide and distribution of streams prior to capture of streams in the southern part of Knoll basin by the Salt Lake drainage system. EC = location of bend in Thousand Springs Creek that defines an elbow of capture. Map from USGS 1:1,000,000 scale Wells and Jackpot topographic maps.
Figure DR3. Shaded relief map showing the wind gap along the drainage divide between the Snake River and Great Salt Lake drainage basins. Location of this map is shown on Figure DR1. Base map from Map data ©2015 Google.


