

The Sabine block, Gulf of Mexico: Promontory on the North American margin?

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Clift et al. (2018) present 1.8–1.6 Ga U-Pb ages for zircons in granite xenoliths that were extracted from the Prairie Creek lamproite, a volcanic pipe in southwestern Arkansas. Because this site lies a few kilometers south of the Ouachita fold-thrust belt, the authors propose that the granites may derive from the northern part of Sabine Block, and that this portion of the North American crust forms a Laurentian promontory in the broad coastal plain of the northern Gulf of Mexico. This scenario is consistent with the stratigraphic analysis of Lowe (1985), though other scientists identify the Sabine Block as an accreted terrane (e.g., Whitmeyer and Karlstrom, 2007).

Though the new crustal age constraints of Clift et al. are relevant to our understanding of the evolution of southern Laurentia, the relationship between the Prairie Creek granite xenoliths and the deep structure of the Ouachita orogen must be clarified. Given that sediments cover the crystalline basement in the southcentral United States, geophysical data help to define the local tectonic setting. Seismic reflection and refraction data from the 1984 Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL) show that Paleozoic strata rest either on rifted continental crust or on ancient oceanic crust at the southern edge of the mountain belt (Keller et al., 1989). This suggests that the Ouachita orogen formed when Paleozoic terranes overrode the southern margin of Laurentia. The Ouachita collision did not lead to much lateral shortening in the Mississippi Embayment, and thus preserved the rifted margin of Laurentia at mid-crustal depths (Keller et al., 1989).

An analysis of wide-angle seismic data from the PASSCAL experiment (Lutter and Nowack, 1990) shows asymmetry in the deep structure of the Ouachita belt. The crust is thicker than 40 km in the north, and seismic wave speeds exceed 7.0 km/s near the Moho, which matches the structure of Proterozoic continental crust worldwide (Durrheim and Mooney, 1991). South of the orogen, crust is ~30 km thick with seismic wave speeds lower than 7.0 km/s (Lutter and Nowack, 1990), which is consistent with the idea that the Sabine Block is an accreted terrane. Near the Texas-Louisiana border, crust of the Sabine Uplift is locally ~40 km thick (Mickus and Keller, 1992), but recent 3-D seismic velocity models from Earthscope show that the average crustal thickness south of the Ouachita orogen is ~30 km (Schmandt et al., 2015). Based on these seismic data sets, it appears that the Ouachita orogen constitutes the southern edge of Laurentia.

If the Ouachita orogen formed in a collision between the south-facing Laurentian passive margin and accreted terranes of the southeastern United States (Mickus and Keller, 1992), the Prairie Creek xenoliths may originate from Laurentian lower crust that underthrust the Paleozoic strata to the south (Griffin et al., 2011). Thomas (2011) suggests that Laurentian lower crust is truncated by the poorly constrained Cambrian Alabama-Oklahoma transform fault in Arkansas. If the Prairie Creek site lies north of this strike-slip boundary, Paleoproterozoic (1.8–1.6 Ga) Laurentian basement rocks here (Clift et al., 2018) would be ~400 m.y. older than U-Pb basement ages of the Granite-Rhyolite Province to the north and west (Van Schmus et al., 1996). This would require a revision of the simplest tectonic model for the growth of the North American continent, where ages progressively decrease from the Archean core toward the southeast (Whitmeyer and Karlstrom, 2007). On the other hand, the new U-Pb dates for southwestern Arkansas do not require that the Laurentian basement extends farther south than proposed by Thomas (2011).

We must also consider the possibility that the Prairie Creek granite is part of an accreted fragment of continental lithosphere of Laurentian or

Gondwanan origin. Continental volcanic arcs may have separated from one of these two larger landmasses after the breakup of Rodinia, and subsequently accreted to the southern margin of Laurentia during the closure of the Paleozoic oceans that separated it from Gondwana. Such a scenario has been proposed for the Paleoproterozoic Mars Hill terrane in the southern Appalachians (Carrigan et al., 2003). Clift et al.'s figure 3 suggests that 1.8–1.6 Ga U-Pb basement ages are not the most common in peri-Gondwanan terranes, which may be generally true (Marzoli et al., 2017). However, in the vast collage of crustal blocks that surround the West African craton, there are also Paleoproterozoic terranes that match the age of the Prairie Creek granite xenoliths very well (e.g., Díez Fernández et al., 2010).

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