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New geologic evidence for additional 16.5–15.5 Ma silicic calderas in northwest Nevada related to initial impingement of the Yellowstone hot spot

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New geologic evidence for additional 16.5-15.5 Ma silicic calderas in northwest Nevada related to initial impingement of the Yellowstone hot spot

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1. Introduction

Although McDermitt caldera, on the Nevada-Oregon border (Figure 1), is frequently shown as the site of initial impingement of the Yellowstone hot spot, new mapping demonstrates that the area affected by this mid-Miocene volcanism is significantly larger than previously appreciated.

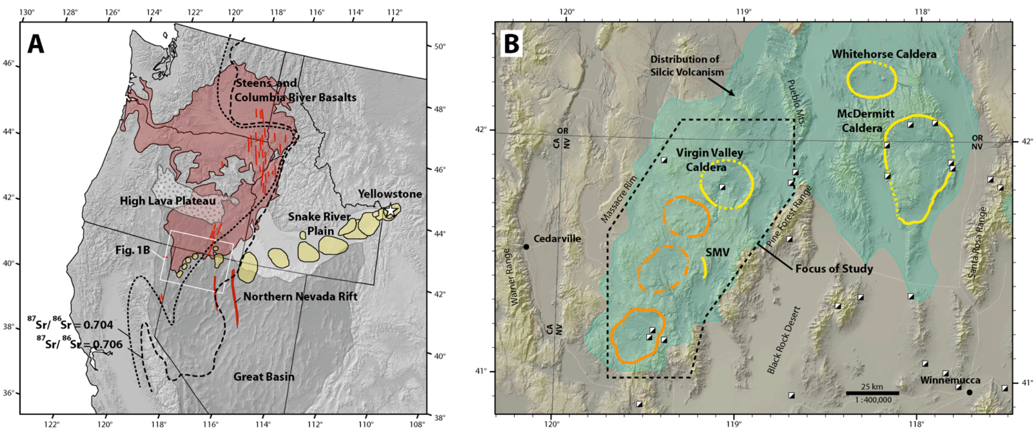

Figure 1. (A) Location map for silicic centers related to the Yellowstone hot spot in the western United States. The calderas (yellow) lie near the southern end of the distribution of the Pueblo, Steens, and Columbia River flood basalts (brown), and mark the intersection of basaltic dikes (red) of the same age and the geophysical anomaly of the Northern Nevada Rift zone. Silicic volcanism youngs to the east in the Snake River Plain. In the High Lava Plateau, the inception of silicic volcanism youngs westward. From Rytuba and McKee (1984), Zoback *et al.* (1994), Bussey (1996), Camp and Ross (2004), Jordan *et al.* (2004), Coe *et al.* (2005), Nash *et al.* (2006), and Brueseke *et al.* (2007). (B) Location map showing mineral deposits (boxes), the known extent of mid-Miocene rhyolitic ignimbrites and lavas (green shading), and the location of mid-Miocene calderas: Whitehorse and McDermitt from Rytuba and McKee (1984), Virgin

Valley from Castor and Henry (2000) outlined in yellow; newly identified by our mapping outlined in orange. The Soldier Meadows lava vent alignment (SMV) of Korringa (1973) is also shown. Mineral deposits from Willden (1964), Rytuba *et al.* (1979), Castor and Henry (2000), and Wallace *et al*. (2004).

2. Analysis

Three silicic calderas have been newly identified in northwest Nevada west of McDermitt caldera (Fig. 1b). Comparing the stratigraphic relations of caldera-forming units to the $^{40}Ar/^{39}Ar$ ages of Castor and Henry (2000), these calderas, along with the Virgin Valley, Whitehorse and McDermitt calderas (Rytuba and McKee, 1984; Castor and Henry, 2000), are interpreted to have formed during a short interval at 16.5-15.5 Ma, during the waning stage of Steens flood basalt volcanism. Outcrops of high-temperature, peralkaline rhyolite ignimbrites occur over approximately 5,000 km^2. Vents for high-temperature, low-viscosity, post-caldera peralkaline rhyolite lavas are interpreted to delineate the location of the now-buried caldera ring faults. The calderas have diameters ranging from 15 to 26 km.

The calderas lie along a NNE trend near, and parallel to, the inferred edge of the North American craton. The calderas occur at the southern end of the distribution of feeder dikes for the Columbia River and Steens basalts, suggesting a relationship between the location of dike-fed flood basaltic volcanism and the development of caldera magmatism in the mid-Miocene. Economically important uranium, lithium, and epithermal gold deposits are associated with these mid-Miocene calderas (Rytuba *et al.*, 1979; Rytuba, 1989; Bussey, 1996; Castor and Henry, 2000; John 2001), occurring in lacustrine sediments and ring-fracture rhyolite lavas (Figure 1b).

Fine-grained caldera lake sediments are preserved in all of these mid-Miocene calderas, indicating how little eroded the calderas are. We have identified major canyons cut by the overtopping of the caldera lakes, suggesting that the region was elevated during the mid-Miocene. The block of crust encompassing the calderas has undergone much less Basin-and-Range normal faulting than regions to the east and west, suggesting that underlying plutons may have made the upper crust in this region stronger than in adjacent areas.

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