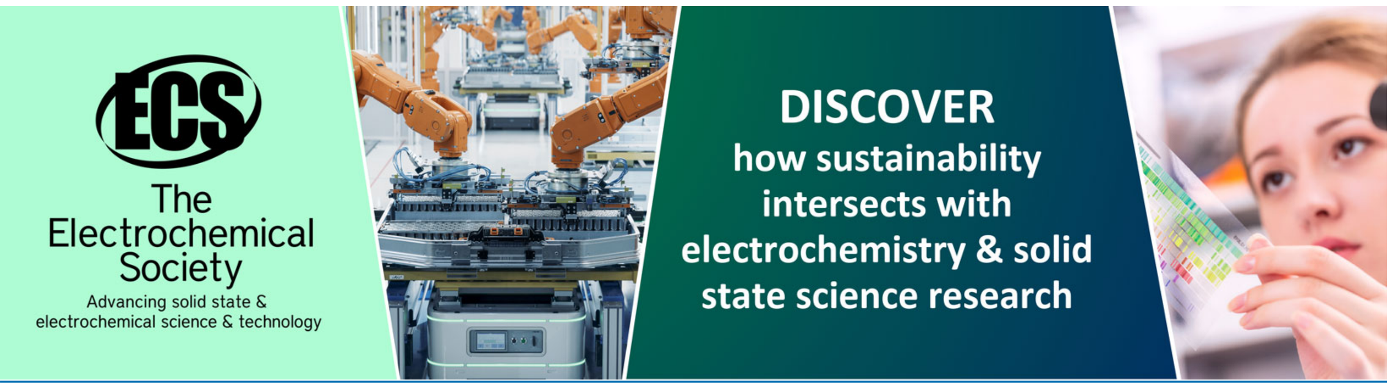
IOP Conference Series: Earth and Environmental Science

OPEN ACCESS

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

To cite this article: Matthew A Coble and Gail A Mahood 2008 *IOP Conf. Ser.: Earth Environ. Sci.* **3** 012002



IOP Conf. Series: Earth and Environmental Science **3** (2008) 012002 doi:10.1088/1755-1307/3/1/012002

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

Matthew A. Coble and Gail A. Mahood
Dept. Geological and Environmental Sciences, 450 Serra Mall, Bldg 320, Stanford University, Stanford, CA 94305-3115, USA

Keywords: Northwest Nevada, Calderas, Peralkaline, Ignimbrite, Yellowstone

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.

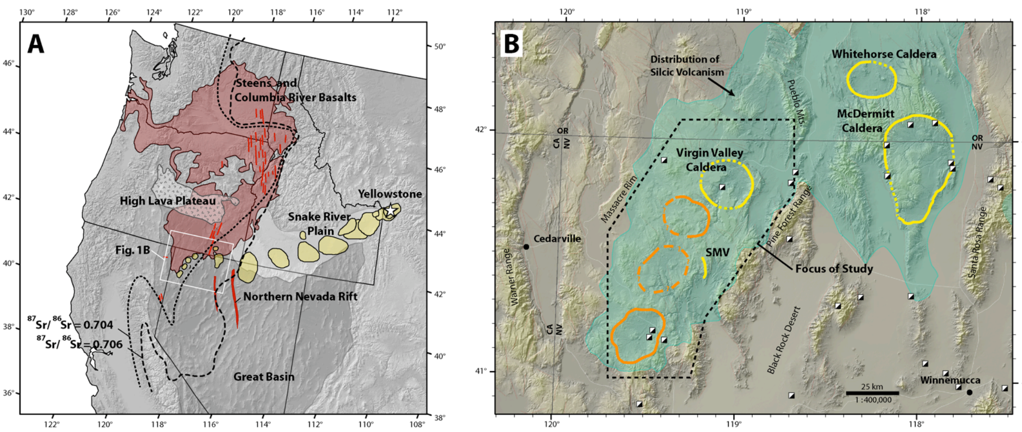


Figure 1. (A) Location map for silicic centers related to the Yellowstone hot spot in the western United States. The calderas (yellow) lie near the southern end of the distribution of the Pueblo, Steens, and Columbia River flood basalts (brown), and mark the intersection of basaltic dikes (red) of the 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.

REFERENCES

Brueseke, M. E., Heizler, M. T., Hart, W. K., and Mertzman, S. A., 2007, Distribution and geochronology of Oregon Plateau (U.S.A.) flood basalt volcanism: The Steens Basalt revisited: Journal of Volcanology and Geothermal Research, 161, 187-214.

Bussey, S. D., 1996, Gold mineralization and associated rhyolitic volcanism at the Hog Ranch District, northwest Nevada, *in* Coyner, A. R., and Fahey, P. L., eds., Geology and Ore Deposits of the American Cordillera: Geological Society of Nevada Symposium Proceedings: Reno/Sparks, Nevada, April, 1995.

Camp, V. E., and Ross, E. R., 2004, Mantle dynamics and genesis of mafic magmatism in the intermontane Pacific Northwest: Journal of Geophysical Research, 109, doi: 10.1029/2003JB002838.

Castor, S. B., and Henry, C. D., 2000, Geology, geochemistry, and origin of volcanic rock-hosted uranium deposits in northwest Nevada and southeastern Oregon, USA: Ore Geology Review, 16, 1-40.

Coe, R. S., Stock, G. M., Lyons, J. J., Beitler, B., and Bowen, G. J., 2005, Yellowstone hotspot volcanism in California? A paleomagnetic test of the Lovejoy flood basalt hypothesis: Geology, 33(9), 697-700.

John, D. A., 2001, Miocene and Early Pliocene epithermal gold-silver deposits in the northern Great Basin, western United States: characteristics, distribution, and relationship to magmatism: Economic Geology, 96, 1827-1853.

Jordan, B. T., Grunder, A. L., Duncan, R. A., and Dcino, A. L., 2004, Geochronology of age progressive volcanism of the Oregon High Lava Plains: Implications for the plume interpretation of Yellowstone: Journal of Geophysical Research, 109, doi: 10.1029/2003JB002776.

Korringa, M. K., 1973, Linear vent area of the Soldier Meadow Tuff, an ash-flow sheet in northwestern Nevada: Geological Society of America Bulletin, 84, 3849-3866.

Nash, B. P., Perkins, M. E., Christiansen, J. N., Lee, D.-C., and Halliday, A. N., 2006, The Yellowstone hotspot in space and time: Nd and Hf isotopes in silicic magmas: Earth and Planetary Science Letters, 247, 143-156.

Rytuba, J. J., 1989, Volcanism, extensional tectonics, and epithermal mineralization in the northern Basin and Range province, California, Nevada, Oregon, and Idaho, *in* Schindler, K. S., ed., USGS research on mineral resources - program and abstracts: Fifth Annual V.E. McKelvey Forum on Mineral and Energy Resources., U.S. Geological Survey Circular, 59-61.

Rytuba, J. J., Glanzman, R. K., and Conrad, W. K., 1979, Uranium, thorium, and mercury distribution through the evolution of the McDermitt caldera complex., *in* G.

W. Newman, e., Rocky Mtn. Assoc. Gaol. Guidebook., ed., Basin and Range symposium and Great Basin field conference, 405-412.

Rytuba, J. J., and McKee, E. H., 1984, Peralkaline ash flow tuffs and calderas of the McDermitt Volcanic Field, southwest Oregon and north central Nevada: Journal of Geophysical Research, 89(B10), 8616-8628.

Willden, R., 1964, Geology and mineral deposits of Humboldt County, Nevada: Nevada Bureau of Mines and Geology Bulletin, 59, 1-154.

Zoback, M. L., McKee, E. H., Blakely, R. J., and Thompson, R. A., 1994, The northern Nevada rift: regional tectono-magnetic relations and middle Miocene stress direction: Geological Society of America Bulletin, 106, 371-382.