

The Deschutes Formation: North America's most recent arc-related ignimbrite flare up

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This project studied the Deschutes formation of the Oregon Cascade range. This formation is located immediately to the east of the current Cascade arc and contains a 5-7 Ma sequence of distal volcanogenic sediments with a high proportion of silicic ignimbrite and tephra fall deposits. The volcanic units are derived from sources within the region of modern-day Cascade arc volcanic front, and mark a period of unusual high production and eruption of silicic magmas immediately following arc rearrangement. Extensive new geochronology, tephra correlations, and field and geochemical data show that volcanism was silicic, highly explosive in characters, and restricted to the period between 6.25 and 5.45 Ma. Overall this period resulted in eruption of at least 400 to 675 km³ (210 to 330 km³ dense-rock equivalent DRE) of magma.

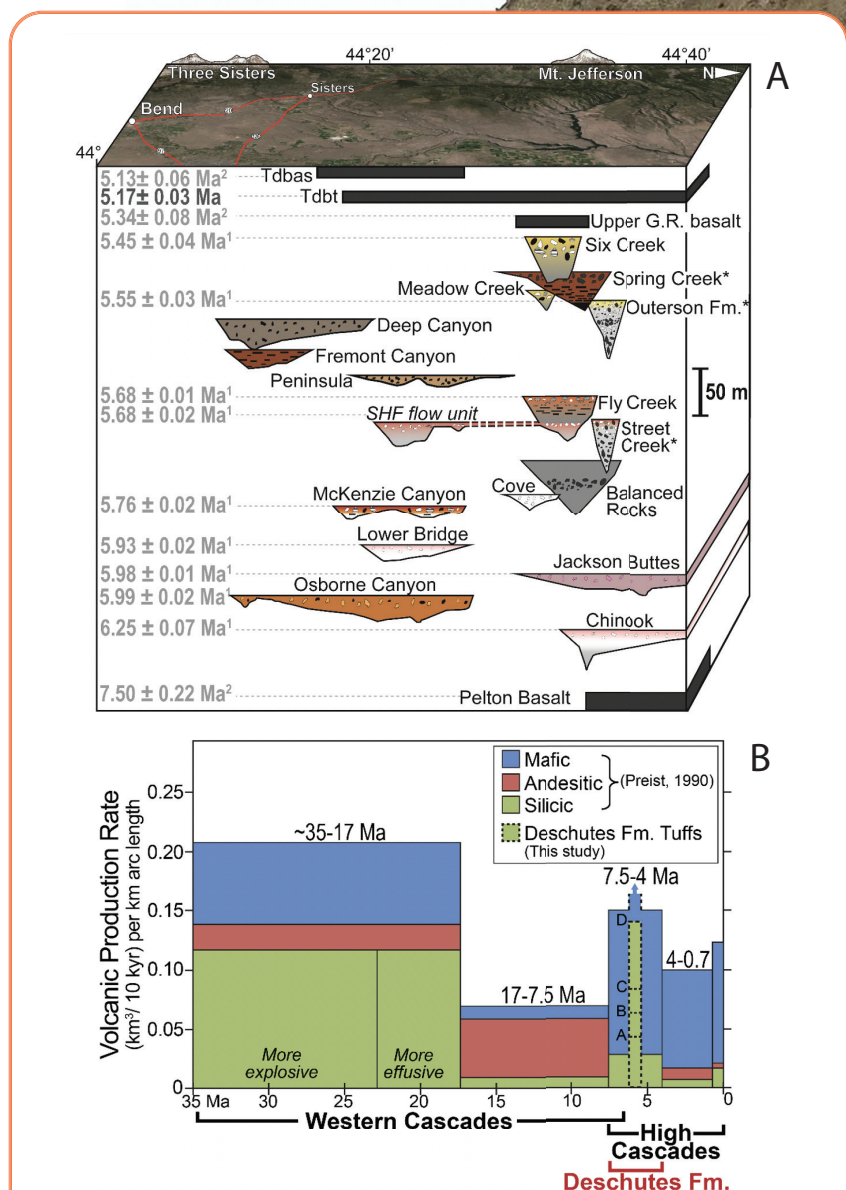
The volumetric output (2.7 to 4.1 km³/10 kyr, DRE) and average frequency of eruptions (1.0 to 1.5 eruptions/10 kyr) during the deposition of the Deschutes Formation are more than a factor of ten greater than the Cascades arc activity outside this interval. The Deschutes Formation thus represents North America's most recent arc-sourced ignimbrite flare-up. We hypothesize that a heightened flux of basalt, induced by slab-rollback following arc reorganization, was focused beneath the arc into the shallow crust by crustal extension. Storage of basalt at shallow levels beneath a new arc locus within fertile crust produced this unusually silicic and explosive period of Cascade arc history. ■

References

Pitcher, B.W., A.J.R. Kent, A.L. Grunder, R.A. Duncan (2017). Frequency and volumes of ignimbrite eruptions following the Late Neogene initiation of the Central Oregon High Cascades. *JVGR*, 339, 1-22

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Figure 1. A. Schematic cross section of the Deschutes Formation with major ignimbrites showing with stratigraphic profile and north-south extent, and major field features. Dates show ⁴⁰Ar-³⁹Ar ages from Pitcher et al. (2017) and sources therein; B. Volcanic eruption rates estimated for the Oregon Cascade arc since 40 Ma from Pitcher et al. (2017) and Priest (1990). Dashed lines show the Deschutes formation and letters refer to different volume estimate methods. Eruption rates during the Deschutes Formation time are significantly great than current (Holocene) rates and the largest in the Oregon Cascade arc in the last 15 million years.





*Dramatic ignimbrite “hoodoos” produced by caprock weathering of the Balanced Rock ignimbrite. The large dark and banded pumice clasts that are characteristic of this unit are evident in the hoodoos.
Photo credit: A. Kent*