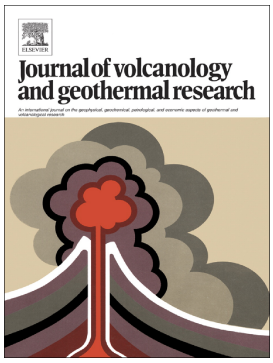

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Frequency and Volumes of Ignimbrite Eruptions Following the Late Neogene Initiation of the Central Oregon High Cascades

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ABSTRACT

The late Neogene Deschutes Formation of central Oregon preserves a remarkable volcanic and sedimentary record of the initial stages of High Cascades activity following an eastward shift in the locus of volcanism at ~7.5 Ma. Numerous ignimbrite and tephra-fall units are contained within the formation, and since equivalent deposits are relatively rare for the Quaternary Cascades, the eruptions of the earliest High Cascade volcanoes were likely more explosive than those of the Quaternary arc. In this study, the timing and frequency of eruptions which produced 14 laterally extensive marker ignimbrites within the Deschutes Formation are established using $^{40}Ar/^{39}Ar$ geochronology. Plagioclase $^{40}Ar/^{39}Ar$ ages for the lowermost (6.25 ± 0.07 Ma) and uppermost (5.45 ± 0.04 Ma) marker ignimbrites indicate that all major explosive eruptions within the Deschutes Formation occurred within a period of 800 ± 54 k.y. (95% confidence interval). Minimum estimates for the volumes of the 14 ignimbrites, using an ArcGIS-based method, range from 1.0 to 9.4 km^3 and have a total volume of 62.5 km^3. Taken over the 50 km of arc length, the explosive volcanic production rate of the central Oregon High Cascades during Deschutes Formation time was a minimum of 1.8 km^3/m.y./km of arc length. By including estimates of the volumes of tephra-fall components, as well as ignimbrites that may have traveled west, we estimate a total volume range, for these 14 eruptions alone, of 188 to 363 km^3 (~121 to 227 km^3 DRE), a rate of 4.7-9.1 km^3/m.y./km arc length. This explosive volcanic production rate is much higher than the average Quaternary eruption rates, of all compositions, estimated for the entire Cascade arc (1.5-2.5), Alaska Peninsula segment of the Aleutian arc (0.6-1.0), and the Andean southern volcanic zone (1.1-2.0). We suggest that this atypical explosive pulse may result from the onset of regional extension and migration of the magmatic arc, which had the combined effect of increasing magmatic flux and temporarily enhancing melting of more fusible crust.

KEYWORDS: Cascade Range volcanic arc; ignimbrites; volumes; eruptive flux; extension; arc migration