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CINDER CONE ANALYSIS AT NEWBERRY VOLCANO, OREGON: A SYNTHESIS OF RESULTS FROM THE EARTH SCIENCE PROGRAM FOR UNDERGRADUATE RESEARCH AT WESTERN OREGON UNIVERSITY

[TAYLOR, Stephen](#)¹, TEMPLETON, Jeffrey¹, PIROT, Rachel², BUDNICK, Jeffrey¹, DRURY, Chandra¹, NOLL, Katherine¹, FISHER, Jamie¹, FALETTI, Anthony¹, GILES, Denise³, and HALE, Diane¹, (1) Earth and Physical Sciences Dept, Western Oregon University, Monmouth, OR 97361, taylors@wou.edu, (2) Dept. of Geology, Portland State University, Portland, OR 97207, (3) Dept. of Geosciences, Oregon State University, Corvallis, OR 97331

Newberry Volcano of central Oregon covers greater than 1600 sq. km and is associated with over 400 basaltic cinder cones and fissure vents (Holocene-Late Pleistocene). It is located in a complex tectonic setting that lies at the junction of the Brothers (west-northwest trending), Tumalo (north-northwest), and Walker Rim (northeast) fault zones. Digital geologic maps and 10-m DEMs were compiled with 177 single and 165 composite cones selected for spatial, morphometric, and volume analyses. The large number of cinder cones provides a robust data set from which to quantitatively test for structural controls on magma emplacement. This work represents a synthesis of results produced over the past four years by the Earth Science Program for Undergraduate Research at Western Oregon University.

Newberry cone positions and morphologic characteristics were compiled and statistically analyzed using GIS. Cone locations were further subdivided into northern (n=181) and southern (n=161) domains to test for mutually independent relations between the three fault zones. Observed cone distribution patterns were tested for randomness and spatial anisotropy using Monte Carlo simulations. Individual cone DEMs were extracted, morphometrically analyzed, and volumes calculated using a kriging-based algorithm. Statistically significant cone patterns were subsequently compared to fault trends to assess the degree to which magma emplacement was guided by regional tectonic stress fields.

The Monte Carlo-based analyses identify four significant cone alignments in the southern domain (dominant azimuth directions = 10-15, 30-35, 325-330, 355), and three in the northern (85, 310, 345). Fault segment analysis reveals three dominant azimuthal trends in the region: 310-325 (Brothers fault zone), 330-340 (Tumalo fault zone), and 45-50 (Walker Rim). In addition, cone-volume distributions show maxima oriented NW-SE, parallel to regional fault trends. The above results suggest that the Brothers and Tumalo fault zones had a detectable control on cinder-cone emplacement in both the northern and southern domains, whereas the Walker Rim is poorly correlated to significant cone distribution patterns. This study provides a framework to guide future geomorphic and geochemical analysis of cinder cones at Newberry Volcano.