Multiple data sets converge on a geologic structural model for Glass Buttes, Oregon geothermal prospect

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Abstract

Geologic field work is being combined with multiple remote sensing and geophysical tools to model fault structure at the Glass Buttes geothermal prospect in central Oregon. Glass Buttes are a Pliocene volcanic center that sits near the junction of the Abert Rim and Brothers Fault Zones. West-northwest-striking faults, which typify the Brothers Fault Zone, bound Glass Buttes. Individual faults and fault intersections are anticipated to provide permeability for utility scale geothermal development in central Oregon. Existing temperature data reveal a maximum of 90° C measured at 600 m, with ~160° C/km bottom hole temperature gradient. High temperature surface alteration, abundant WNW-oriented faulting, and reported drilling mud losses indicate likely commercial temperatures and fracture-controlled permeability at depth. LiDAR, hyperspectral mineral mapping, and field mapping constrain near-surface structure and volcanic contacts; aeromagnetic data constrain surface to intermediate (<1000 m) structure; and gravity data constrain deeper structure (surface-2000 m). Data sets agree reasonably well in some areas, although gravity data reflect a few deep-seated faults more than the densely faulted surface structure. On the east side of the prospect, these interpreted faults trend ENE, nearly perpendicular to observed surface structures. To the north of Glass Buttes, a curvilinear gravity high and topographic low indicate that Glass Buttes sits on the southern end of a previously unidentified buried caldera or graben. Interpretation of subsurface and gravity data do not uniquely distinguish between these alternative interpretations. Exploratory drilling will target intersections of surface faults with deeper gravity-defined features.

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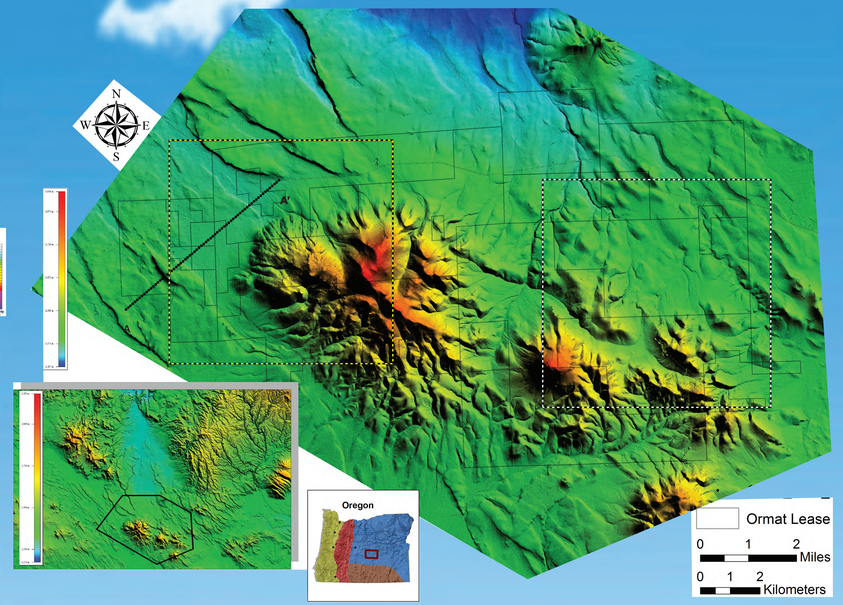
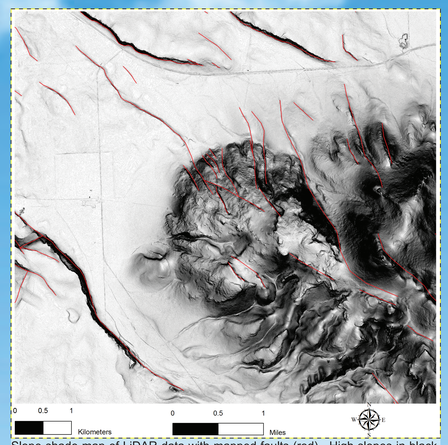
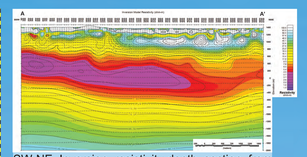


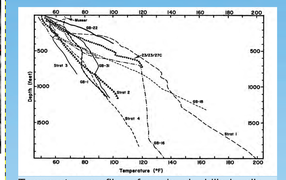
Digital elevation model (DEM) with shaded relief. Dashed boxes outline areas of detail for the rest of the poster. All figures to the right correspond with the same area and scale as the eastern box; all images to the left correlate with the western box. Large inset map includes shaded relief DEM from US NED 30 m and outline of LiDAR data displayed in main figure. Small inset includes physiographic provinces of Oregon(USGU) and outline of large inset. Physiographic provinces include Pacific border (yellow), Cascade-Sierra Mountains (red), Basin and Range (brown), and Columbia Plateau (Blue).



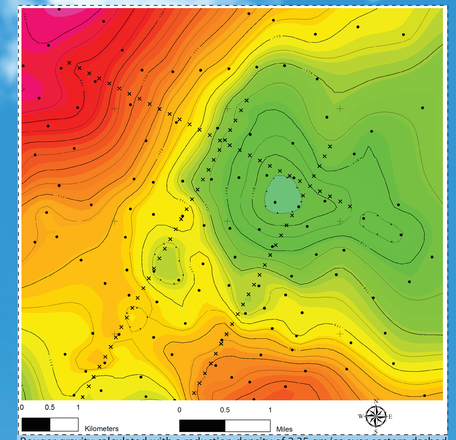
Slope-shade map of LiDAR data with mapped faults (red). High slopes in black, low slopes in white. Glass Butte is the high relief area on the east side of the map. Parmele Ridge Fault is the prominant feature on the southwest side of the map.



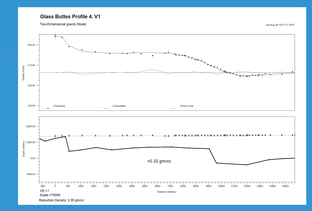
SW-NE Inversion resistivity-depth section from one-dimensional inversion of the tensor determinant resistivity. Location indicated by A-A' on DEM map.



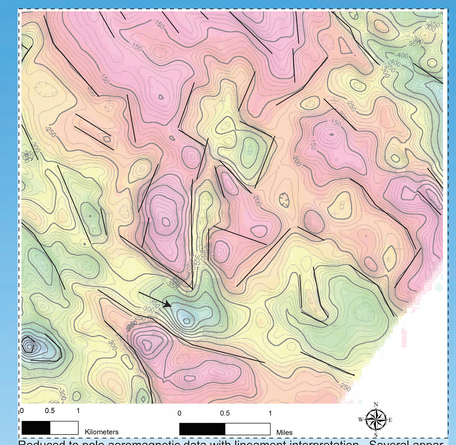
Temperature profiles of previously drilled wells. (Johnson and Ciancanelli, 1983, GRC Transactions)



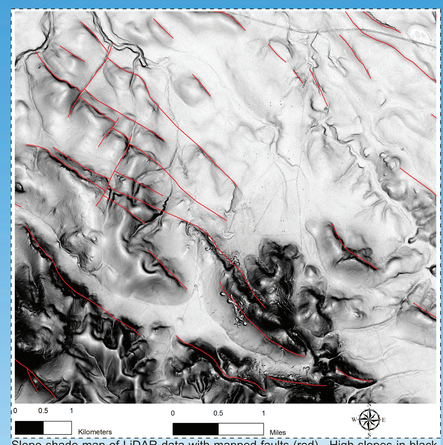
Bouger gravity calculated with a reduction density of 2.35 gm/cc over eastern dashed area shown on DEM map. Black dots and x's mark station locations. Contour interval is 0.5 mgal. Intersection of NNE-trending and ESE-trending structure may provide fluid conduit. Gravity low in northeast area would typically be interpreted as downthrown to both faults, in contrast with results from MT data.



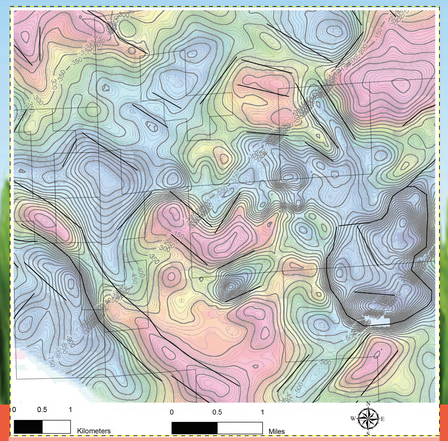
Preliminary density models illustrate amiguity in gravity data. These models will be recreated following information from MT data indicating dominant west-dipping fractures.



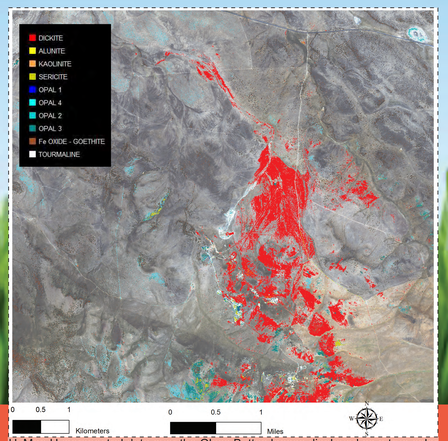
Reduced to pole aeromagnetic data with lineament interpretation. Several apparent structures correlate with faults mapped from LiDAR or on the surface (image to the right). Low magnetic susceptibility in the southeast correlates with area of hydrothermal alteration (e.g. hyperspectral image below left). The area of lowermagnetic susceptibility indicated by the arrow may indicate buried alteration.



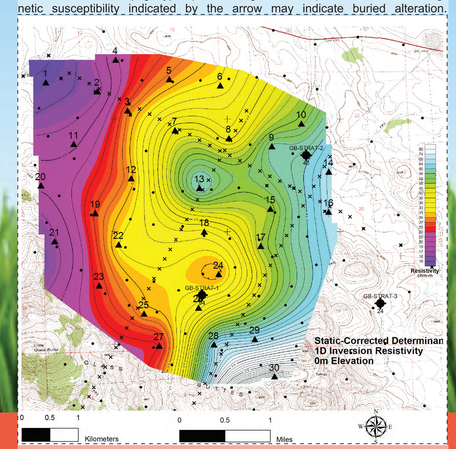
Slope-shade map of LiDAR data with mapped faults (red). High slopes in black, low slopes in white. Note extensive mining disturbance feeatures in the south-central portion of the image.



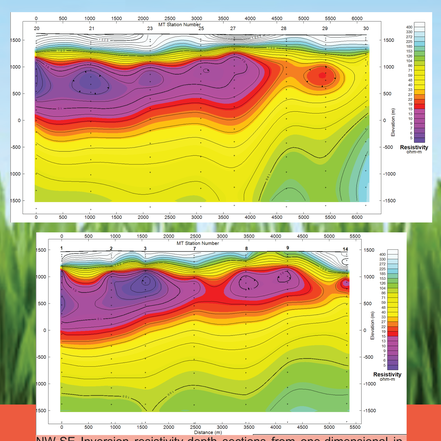
Reduced to pole aeromagnetic data with lineament interpretation.



HyMap Hyperspectral data over the Glass Buttes leases displayed as a true color image. Extremely bright, disturbed areas will appear white to light blue/cyan. Overlay pixels colored according to mineralization described in inset legend. Classification from full spectral unmixing algorithms.



1D inversion results of static-corrected determinant resistivity for an elevation of 0 m , or approximate target depth for first slim well. North-south gradient is likely to be high angle faulting, as shown on sections to the right.



NW-SE Inversion resistivity-depth sections from one-dimensional inversion of the tensor determinant resistivity. Station numbers correspond with MT figure to the left. Both sections indicate high-angle down to the west faulting.

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