that the Los Pinos gabbro is an erosional cross section through a late Jurassic volcano. The inner olivine gabbro may then represent the magma chamber and its differentiation products whereas the comb structures may have been fluid-rich channels that marked the boundaries between the enclosing rocks and the inward-crystallizing front of the magma.

TRANSGRESSIVE AGE OF LATE CENOZOIC SILICIC VOLCANIC ROCKS ACROSS SOUTHEASTERN OREGON; IMPLICATIONS FOR GEOTHERMAL POTENTIAL

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Rhyolite, rhyodacite, and dacite domes and flows are common in and south of the northwest-trending Brothers fault zone that extends from Newberry Volcano near Bend to the eastern margin of Harney Basin and possibly beyond. Regional geologic evaluation by Walker indicated that the silicic rocks are progressively older in a southeastern direction away from Newberry Volcano, where the rhyolitic rocks are Pleistocene and Holocene in age. This is confirmed by K/Ar dates. The distance of major silicic rock masses from Newberry Volcano and their isotopic ages are: China Hat, East Butte, and Quartz Mountain, 15 to 30 km, 1 m.y. and less; Cougar Mountain and Frederick Butte, 40 to 60 km, about 4 m.y.; Glass Buttes, 100 km, about 5 m.y.; Horse Mountain, Owen Butte, Drews Ranch, Cougar Peak, Thomas Creek, McComb Butte, and Tucker Hill northwest of Lakeview, 110 to 160 km, about 7 m.y.; Palomino and Burns Buttes near Burns, 160 and 170 km, 6 and 8 m.y.; Beatty Butte, 210 km, 10 m.y.; and Duck Butte, 260 km, 10 to 11 m.y. The ages increase toward the southeast at an approximate rate of 2 cm per year. This temporal relation and association of the silicic masses with a major fault zone suggests a tectonic control of magma genesis that may be related to plate movement or mantle convection.

Young shallow silicic volcanic bodies serve as heat sources for most, if not all, commercial geothermal fields. The age relations in southeastern Oregon suggest that silicic bodies young enough to be commercially attractive as heat sources may occur near the northwestern end of the Brothers fault zone.

INTEGRATED EXPLORATION IN GEOTHERMAL AREA

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Preliminary testing of an integrated exploration system designed for detection, delineation, and evaluation of potential geothermal resources in the State of Utah has been in progress since June 1973. It is intended to use photo-interpretation, field mapping, structure, petrology, geochemistry, microearthquakes and seismic noise, heat flow, resistivity and induced polarization, gravity, electromagnetics, magnetotellurics and magnetics in a modular exploration program designed for optimum definition of earth models applicable to the area under investigation.

The Fumarole Butte area, near Delta, Utah, was selected as the first field site because of the presence of a thermal spring and basalt stock isolated from known major faulting. The data resulting from the geophysical studies have been formally inverted to yield earth models. Attempts are being made to invert several sets of data simultaneously so as to constrain the ranges of parameters of earth models which satisfy these data sets.

The geochemical and petrological data plus the surface outcrops have been analyzed to deduce geologic models which pose constraints on the geophysical models. The importance of geophysical methodology to solution of one geological problem occurring in the Basin and Range is illustrated in the progress report.

SHONKINITE-SYENITE PLUTONS, MOUNTAIN PASS, SAN BERNARDINO COUNTY, CALIFORNIA

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Four Precambrian plutons composed mainly of shonkinite and syenite and three composed mainly of syenite, quartz syenite, and granite occur near the large rare-earth bearing carbonatite at Mountain Pass. The two best-exposed shonkinite-syenite plutons, and other critical areas, were mapped at 1:600. Units within these plutons, and associated dikes, are, in intrusive sequence, biotite shonkinite, biotite-amphibole syenite, syenite, quartz syenite, and granite. Time of emplacement of minette dikes overlaps as well as post-dates the emplacement of syenite and granite; rare phlogopite-carbonate dikes appear to be the youngest intrusive. The plutonic rocks consist mainly of biotite, aegirine-augite, hornblende, riebeckite, and K-feldspar in various proportions. Mean compositions, based on 95 analyzed rocks are:

	SiO	Fe_2O_3	MgO	CaO	Na_2O	K_2O
Biotite-shonkinite	48.2	7.6	11.6	5.8	1.0	7.8
Biotite-amphibole syenite	53.7	7.3	6.1	2.9	1.5	9.9
Amphibole syenite	59.8	5.8	1.3	1.2	1.9	11.5
Syenite	63.0	4.6	.7	.6	2.5	9.8
Quartz syenite-granite	64.8	3.9	.9	.9	3.1	7.9
Minette	51.5	7.5	7.4	5.3	1.6	7.8
Phlogopite-carbonate	44.0	8.8	11.4	8.8	3.1	5.0

The geological maps show no evidence that the plutons underwent differentiation in place or that the plutons differentiated in place were disrupted tectonically. The distribution of rock types and intrusive sequence may indicate intrusions from more than a single differentiating source.

HOLOCENE MOVEMENT ON THE SAN GREGORIO FAULT ZONE NEAR ANO NUEVO, SAN MATEO COUNTY, CALIFORNIA

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A major fault zone branches off the San Andreas fault at Bolinas Lagoon north of San Francisco and extends 150-200 km south-southeast subparallel to the California coastline to the vicinity of Point Sur south