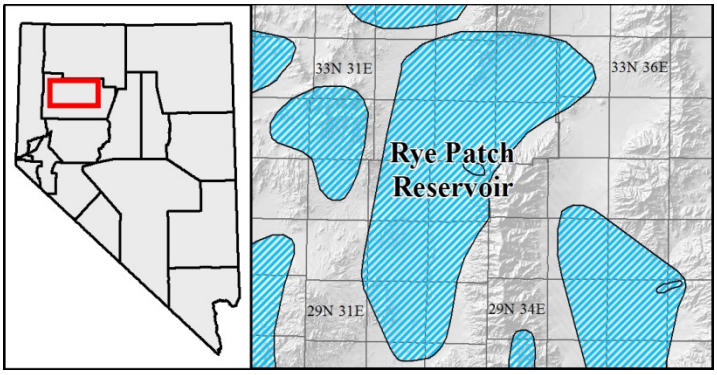
Site Description

Rye Patch Reservoir
(updated 2014)



Geologic setting:

The Rye Patch geothermal area is located in the Humboldt River valley west of a major north-striking range-front fault, the Humboldt Range Fault.

In February 2004, five well cores were studied using geochemical and petrographic techniques at the University of Nevada, Reno (Humboldt House logs, Humboldt House graph, Rye Patch graph) in a US DOE funded project of two masters students in collaboration with Presco Energy. Triassic rocks were encountered below several hundred meters of Tertiary sedimentary and volcanic rocks (including sinter?). A sandstone and siltstone unit, at about 1,000-m depth, was intersected within the predominantly carbonate-rock section of the Triassic Natchez Pass Formation. The sandstone and siltstone unit is apparently the productive part of the stratigraphic interval; faults may control fluid migration in the reservoir (Feighner and others, 1999). Also, carbonate rocks of the Natchez Pass Formation were found to be productive in a well deepened to 643 m in 2002; reservoir temperatures were reported to be about 150°C (U.S. Department of Energy, in Geothermal Resources Council Bulletin, v. 31, no.4). Geophysical data for the area are reported by Duffrin and others (1985) and Schaefer (1986). For additional information on geology and exploration history see Mansure and others (2001), Waibel and others (2003), Johnson and others (2004), and Warpinski and others (2004). Areas of hydrothermal silica and drill-hole locations are shown on a map compiled by GeothermEx (2004, Fig. RYE00-1).

Geothermal features: (Rye Patch Map; Humboldt House Map; North of Humboldt House Map)

Rye Patch, Humboldt, or Humboldt House, 50 km north of Lovelock, was founded in 1868 as an eating station along the Central Pacific Railroad. No thermal springs are known from the area, but Pleistocene(?) sinter crops out nearby. These siliceous and calcareous spring deposits occur as low domes in two areas to the south and to the west of Humboldt House. These hot-spring deposits contain sulfur, gypsum, and detectable amounts of mercury (Russell, 1885, p. 54, 55; Vanderburg, 1936, p. 17; Bailey and Phoenix, 1944, p. 107). One locality is in SW¼ SE¼ Sec. 33, T32N, R33E, and consists of a sinter mound about 305 by 213 m. The second locality occurs in an area of Quaternary sandstone in NW¼ SW¼ Sec. 32, T32N, R33E, and is about 150 m in diameter (Olcott and Spruck, 1961).

MacKnight and others (2005) identified more extensive areas of spring deposits and correlated them with concealed faults west of and parallel to the main Humboldt Range fault. The area of spring deposits is about 1.6 km west of this major fault, which separates Mesozoic rocks and surficial deposits. Audiomagnetotelluric data for the area is available in Long and Batzle (1976c).

A warm spring reported by Crofutt (1872) (Sec. 20, T30N, R33E) could not be found in subsequent studies. Hot water (75.6°C) flows from an old mineral exploration hole in SE¼ Sec. 32, T32N, R33E. Geothermometry on this fluid led Phillips Petroleum Co. to explore the area (W.L. Desormier in Lane,

Site Description

1979). In 1977, Phillips Petroleum Co. drilled a 565-m-deep geothermal test in SE¼ Sec. 21, T31N, R33E, with temperatures up to 163°C. Temperatures reached 204°C in later wells, and geothermometers suggest a resource temperature of at least 243°C (Ehni and Ellis, 2002).

Geothermal drilling at Rye Patch in the late 1980's and early 1990's resulted in one successful well; others were too cold or had no fluid flow (Feigner and others, 1999). Mt. Wheeler Power sold the project to Presco Energy LLC of Englewood, CO. The U.S. Department of Energy provided funding ($1.62 million) to study and help define the resource at Rye Patch (www.eren.doe.gov/geothermal/).

The University of Nevada, Reno received DOE funding to expand the resource at Florida Canyon Mine. Between May and July 2003, UNR conducted exploration and test drilling in partnership with Presco Energy and Apollo Gold. Five gradient wells (drilling report) were drilled near the Florida Canyon Mine (map; project update): one well to 500 feet, three wells to 1000 feet, and one well to 1500 feet. A total of 1850 feet of core was obtained from three wells. Extensive silicification and veining was observed in the 1000 ft corehole, but none of the wells encountered measurable water inflows (Johnson et al, 2004). Recently, gravity, magnetic, LIDAR and seismic data were collected at the Rye Patch site and used to revise the structural model of the area (Ellis, 2011).

Florida Canyon: Florida Canyon coincides with the Imlay mining district, a mercury-gold-silver producing region along the north slopes of Humboldt Range. The northern Humboldt Range hosts a complex pattern of Prida, Natchez, and Grass Valley Formations, overthrust along the Humboldt City fault. Diabasic dikes and sills intruded the Triassic-era formations, and gave rise to sediment-hosted, disseminated gold within the Grass Valley Formation (Johnson, 1977).

Wells at the Florida Canyon Mine produce 100°C fluids from ~175-m deep (NW¼ Sec. 3, T31N, R33E). In the late 1980's, these fluids were circulated through heat exchangers for heap leaching.

The Florida Canyon geothermal project is a small power generation unit associated with the Florida Canyon gold mine in T31N, R33E. This mine has been active for approximately 20 years, and is adjacent to the Rye Patch/Humboldt House geothermal area.

In 2009 and 2010 a small, 50-kW geothermal plant manufactured by ElectraTherm (Reno, NV) operated for a thousand hours at the Florida Canyon gold mine. This "Green Machine" used in the project is a low-temperature Organic Rankine Cycle (ORC) unit designed to convert low-temperature waste heat into electricity. Although the unit produced less than 5% of the mine's electrical needs, it produced electricity from otherwise unused heat from one of the mine's hot wells. ElectraTherm was awarded a $982,000 Phase 1 DOE research grant at the end of 2010 to optimize their Green Machine to specifically use geothermal brines, with Florida Canyon as the test site. Successful R&D during 2011 caused the DOE to award additional funding for Phases II and III to manufacture and commission a newly developed, more powerful 75 kWe "geothermal" Green Machine with a cleanable heat exchanger. The unit has been built and was tested in 2011 at ElectraTherm. It was installed at the Florida Canyon Mine and successfully commissioned in 2012. The 75 kWe plant is operating on 225-230°F (107-110°C) water flowing into the unit at 150 gpm (Electratherm web site, July 2013; http://electratherm.com/case_studies/geothermal_in_nevada/). The only other unit in Nevada

producing at such low temperatures is located at the Wabuska geothermal site, which was first commissioned in 1984.

Presco Energy has rebranded the Rye Patch area as 'Star Peak Energy' and is working on creating a 'renewable energy oasis' utilizing baseload geothermal energy and developing additional renewable power resources such as solar, wind, and storage (Star Peak Energy website, Feb. 2014; http://www.starpeakenergy.com/).

Mill City: A warm spring has been reported near Mill City, without measured temperature or chemistry. Mill City and the Eugene Mountains have historically been considered part of the Central Mining District, a copper and tungsten producing region. The Eugene Mountains are composed of Triassic shales, quartzites, and limestone, intruded by Cretaceous-Tertiary granodiorite (Bonham et al., 1985).

NE Trinity Range: Warm gradient holes were drilled 5-10 miles SSW of Rye Patch Reservoir, six of them in the NE Trinity Range foothills. The foothills coincide with the Arabia mining district, underlain by Cretaceous granodiorites, Triassic metasediments, and minor volcanics. Lead-silver-antimony deposits appear in granodiorite fractures and metasedimentary xenoliths (Johnson, 1977).

Leasing information:

In 2009, Presco Energy LLC leased >1,400 acres in the Rye Patch area from the BLM competitive geothermal lease sales. They also absorbed Rye Patch Ltds' leases. In 2013, Presco Energy Co. leased a further 1,366 acres in the Rye Patch geothermal region during the March BLM geothermal lease sale, and another block of 1320 acres in the November 2013 lease sale.

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Site Description

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