CASTLEVALLEY GREENHOUSES, NEWCASTLE

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Castlevalley greenhouses showing geothermal water supply lines.

BACKGROUND ON ESCALANTE VALLEY

Newcastle, Utah is a rural farming community located about 30 miles west of Cedar City, Utah along the southeastern edge of the Escalante Valley in Iron County. The Newcastle geothermal resource, low-to-moderate temperature hydrothermal system, was accidentally discovered in 1975 during an aquifer test of an irrigation well. Upon pump-testing of the well, Christensen Brothers--a local farming company (owners of Castlevalley Greenhouses)--discovered that the well had penetrated a geothermal aquifer. Termed a "blind" geothermal resource, there are no obvious surface manifestations such as hot springs or fumaroles to suggest that a geothermal system is present at depth. The water in the well was near the boiling point and reportedly flashed to steam when pumped to the surface. Subsequent studies by the University of Utah, Department of Geology and Geophysics (Chapman, et al., 1981), the Utah Geological Survey (UGS) (Blackett and Shubat, 1992) and the University of Utah Research Institute (Ross, et al., 1990; 1994) defined a buried zone of suspected geothermal upflow along the nearby Antelope Range fault that they postulate as the source of the hot water.

Studies also defined a shallow aquifer that channel the outflow of geothermal fluids into the subsurface of the Escalante Valley. Geothermal production wells, typically 500 ft (150 m) deep, tap the geothermal fluid in this unconfined aquifer. The fluids cool by conduction and probably mix with shallow groundwater at the system margins. A maximum temperature of 266°F (130°C) was measured in a 1981 geothermal exploration well (CHR-1), which penetrated the geothermal aquifer (outflow plume). Exploratory drilling in the summer of 2001 in the same location as CHR-1, however, yielded lower temperatures (~243°F, 117°C). Production wells at the greenhouses generally yield fluids in the range of 167 to 203°F (75 to 95°C). Chemical signatures or "geothermometers" suggest maximum resource temperatures of 266 to 302°F (130 to 150°C).

GEOTHERMAL STUDIES

Blackett and Shubat (1992) prepared a case study of the Newcastle geothermal system based on previous work and the results of detailed geologic mapping and various geophysical surveys. D. S. Chapman (Blackett, et al., 1990) developed a heat-flow map of the Newcastle area using data from about 30 exploratory, thermal-gradient drill holes. He reported an anomalous heat loss of 12.4 thermal megawatts (MW_t). A more recent calculation (Ross, et al, 1994), which accounted for corrected well positions and used the method of Chapman, yielded an anomalous heat loss of 13.8 MW_t. Ross and others (1990) completed electrical resistivity and self-potential (SP) studies which provided independent evidence for the location of the thermal fluid up-flow zone. A well-defined 108 millivolt (mV) SP minimum was mapped between temperature-gradient monitor wells with greatest heat flow and

above the projected intersection of northwest-trending structures with the Antelope Range fault. Two lesser minima of -44 mV and -36 mV were also mapped to the southwest, above the buried Antelope Range fault. Numerical models of dipole-dipole resistivity profiles resolve near-vertical low-resistivity (4 ohm-m) bodies which are interpreted as up-flow zones. A low-resistivity (4 ohm-m) layer at a depth of about 150 ft (45 m) within the alluvium extending to the northwest is interpreted as the geothermal outflow plume.

UTILIZATION

Castlevalley Greenhouses consists of nine arched, double plastic covered building heated with 210°F (99°C) water. These greenhouses cover an area of about 33,750 ft^2 or 0.77 acres (0.31 ha) Water at around 350 gpm (22 L/s) is supplied to fan coil heaters at the end of each house. The main crop is tomatoes grown hydroponically. These are marketed by the owners through southern Utah. A few bedding plants are also grown.

Interior of a greenhouse showing the hydroponic growing system.

Fan coil heaters at the end of a greenhouse.

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