Some Geothermal Data for Southern Arizona

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Outline

- Introduction for Jim Witcher’s talk
- Physiographic & Geothermal Setting
- Selected data sets that indicate likely geothermal resources in southern Arizona (south of 34° north)
- Prospects for use of geothermal heat pumps in southern Arizona (energy conservation)
Arizona Topography
US Heat Flow – Arizona-New Mexico

SMU Geothermal Lab, Geothermal Map of United States, 2004
Arizona Hot Springs – Above Ambient Temperature
Southern Arizona Hot Springs

Spring Temperature - Mean Surface Temperature

Spring $\Delta T$, °C
- 61-70
- 51-60
- 41-50
- 31-40
- 21-30
- 16-20
- 11-15
- 0-10
Arizona Heat Flow
Southern Arizona Heat Flow

Heat Flow

Heat Flow, mW m⁻²
- > 150
- 130-149
- 110-129
- 90-109
- < 30
Southern Arizona Na-K-Ca GeoT Data

Na-K-Ca Water Geochemistry Temperature

Na-K-Ca GeoT, °C
- 126-150
- 101-125
- 76-100
- 51-75
- 26-50
- < 25
Summary

- US Heat Flow map shows potential for low-temperature geothermal resources for most of southern Arizona.
- Major hot springs on near Mogollon Rim.
- High heat flow (typical of Basin and Range) for most of southern Arizona.
- Na-K-Ca Water Geochemistry Data indicate widespread resources up to 100°C (212°F), locally hotter.
Geothermal Heat Pump
Cooling Mode

Geothermal Heat Pump Efficiency vs. Ground Temperature

COP = Coefficient of Performance = Total energy output from heat pump/Electrical energy input to heat pump

Mean Annual Surface Temperature in Arizona

Mean Annual Air Surface Temperature vs Elevation

$y = -0.0038x + 75.609$

$R^2 = 0.9242$

$T = 75.6^\circ F$ at 0 feet
Decrease by 3.8$^\circ F$ per 1000 feet

$T = 24.2^\circ C$ at 0 m
Decrease by 6.9$^\circ C$ per km
Southern Arizona Mean Annual Air Surface Temperatures
Summary of Geothermal Potential for Use of Geothermal Heat Pumps in Southern Arizona

- Widespread use of compressor-type air-conditioner units in southern Arizona suggests potential increased efficiency (energy conservation) through the use of geothermal heat pumps (GHP).
- Range of surface air temperatures in southern Arizona indicates efficiencies of $>250\%$ for GHP neglecting energy used for ground heat exchange.
- The challenge for the use of GHP in southern Arizona will probably be in efficient ground heat exchange because the water table is often relatively deep in this region.