

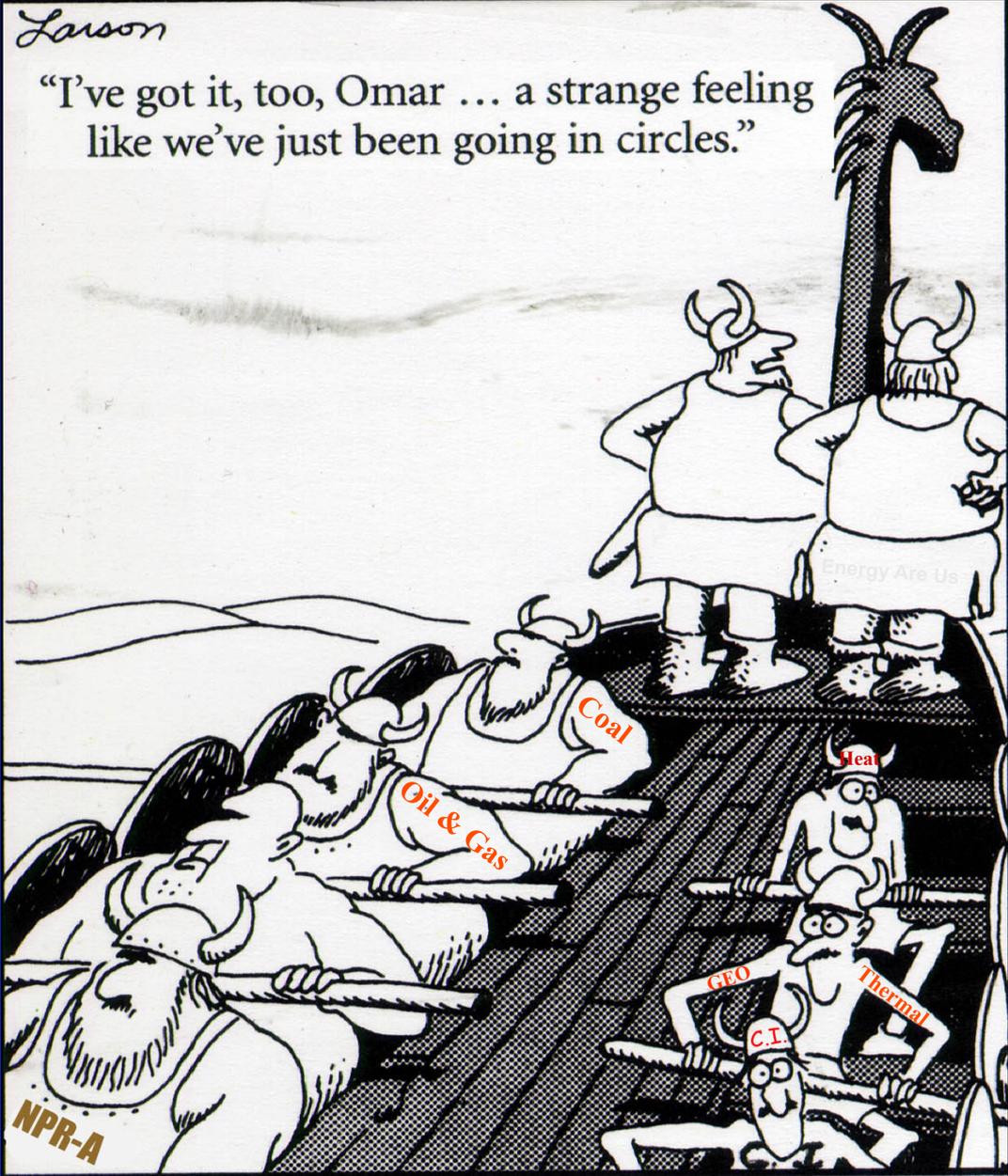
Geothermal Energy in Alaska



**R.F. Swenson, State Geologist & Director
Alaska Division of Geological & Geophysical Surveys**



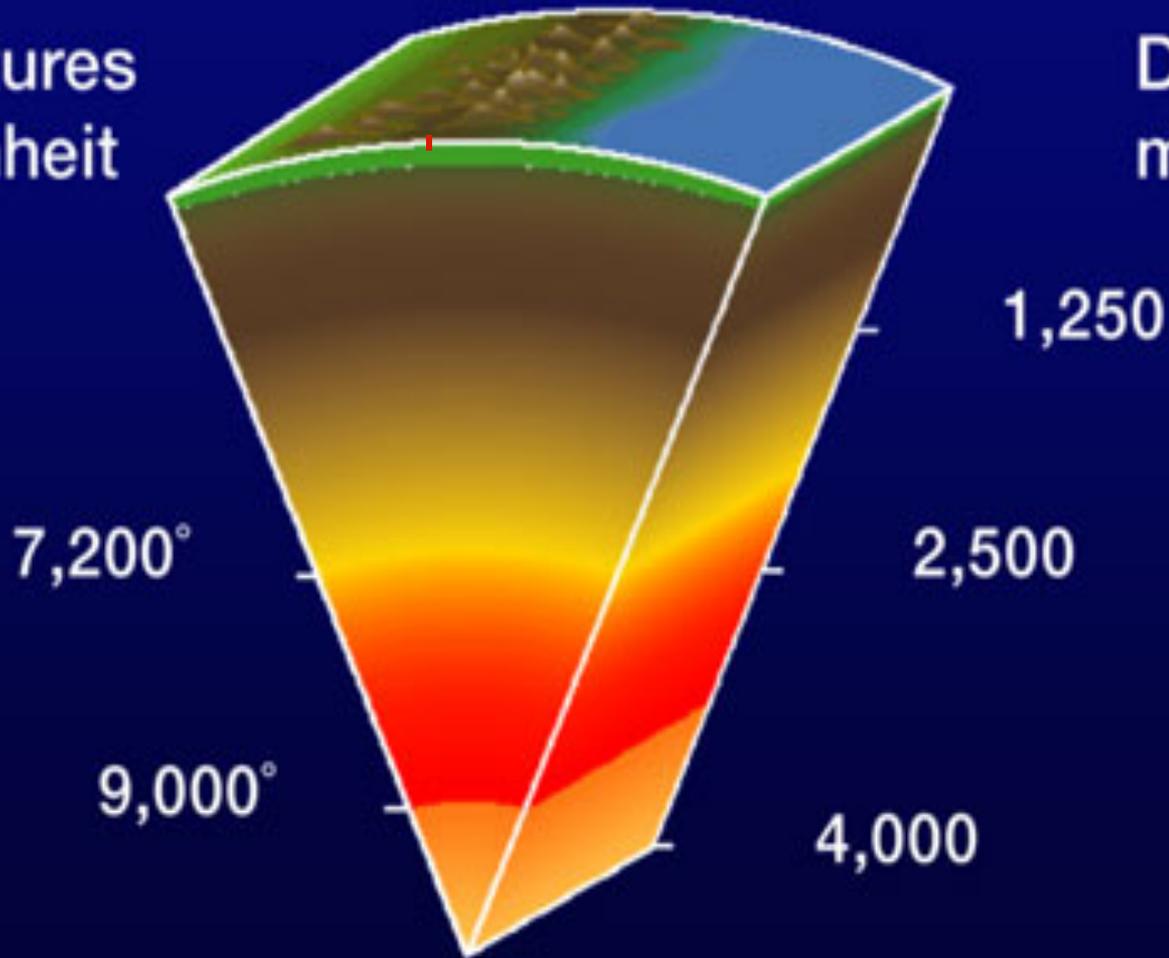
Working Geothermal in the US



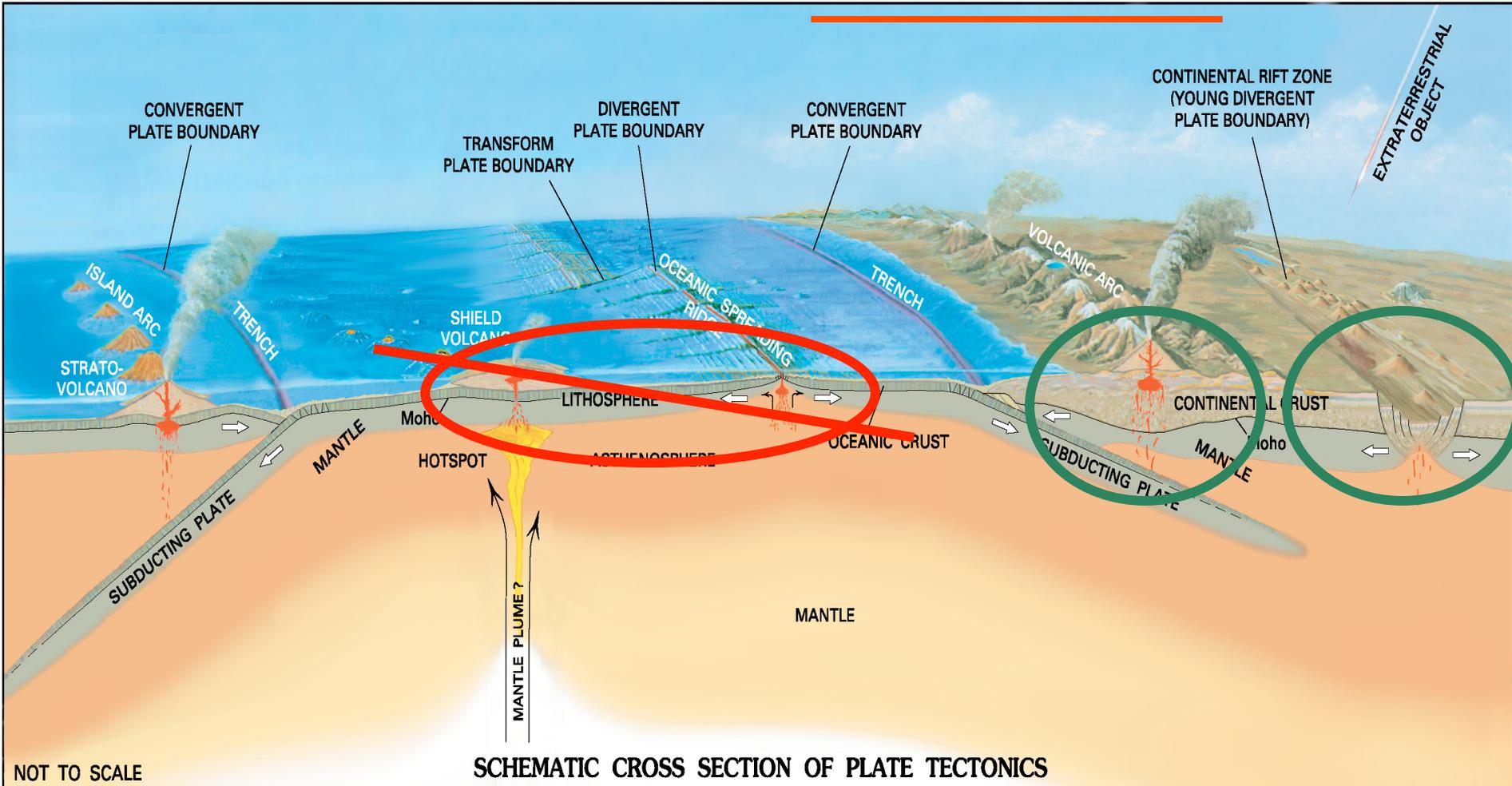
Temperatures in the Earth

Temperatures
in Fahrenheit

Depth in
miles

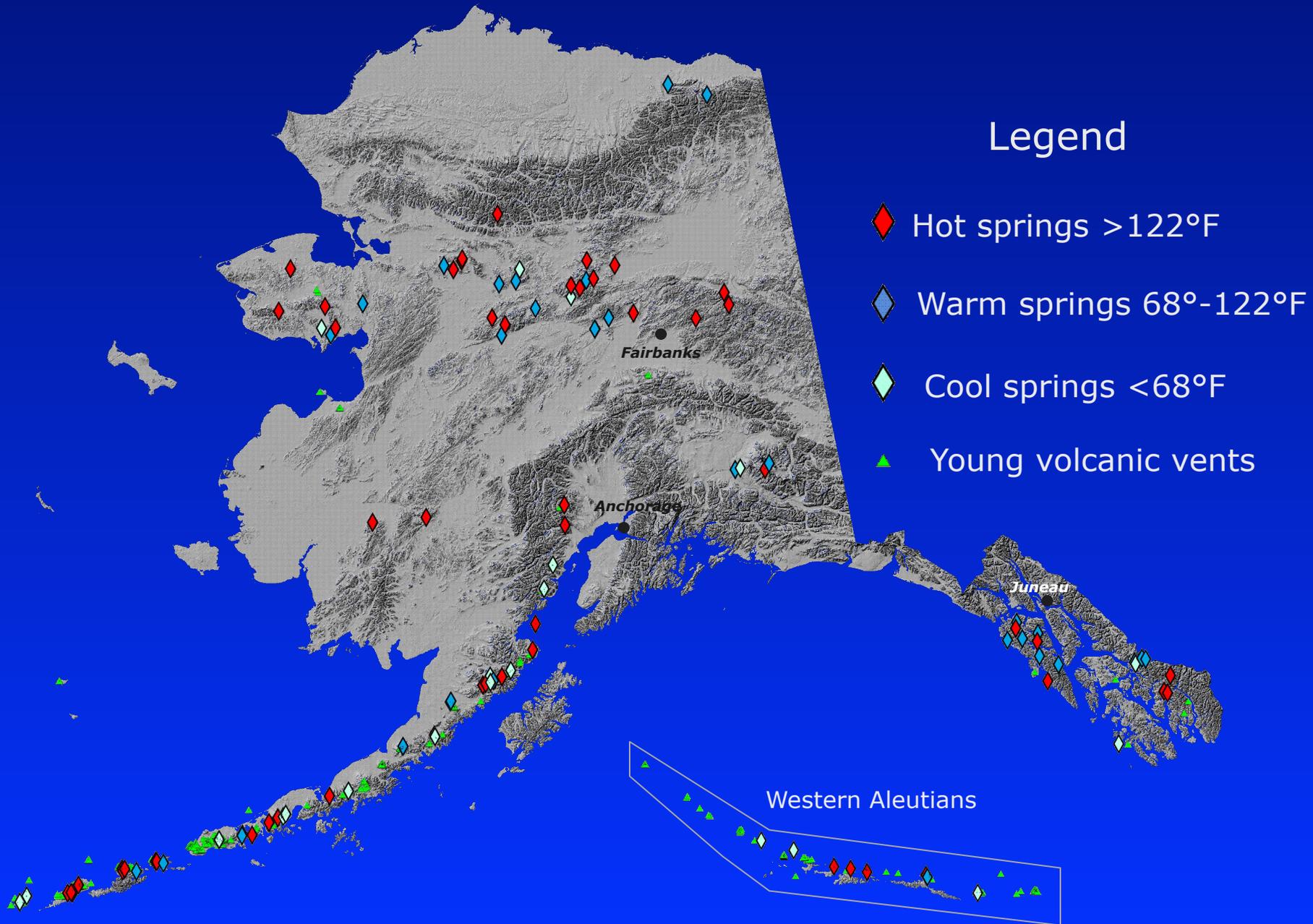


Geothermal & Geologic Settings



José F. Vigil and Robert I. Tilling

Alaska Geothermal Anomalies



Alaska Geothermal

61 hot springs (hotter than 122°F)

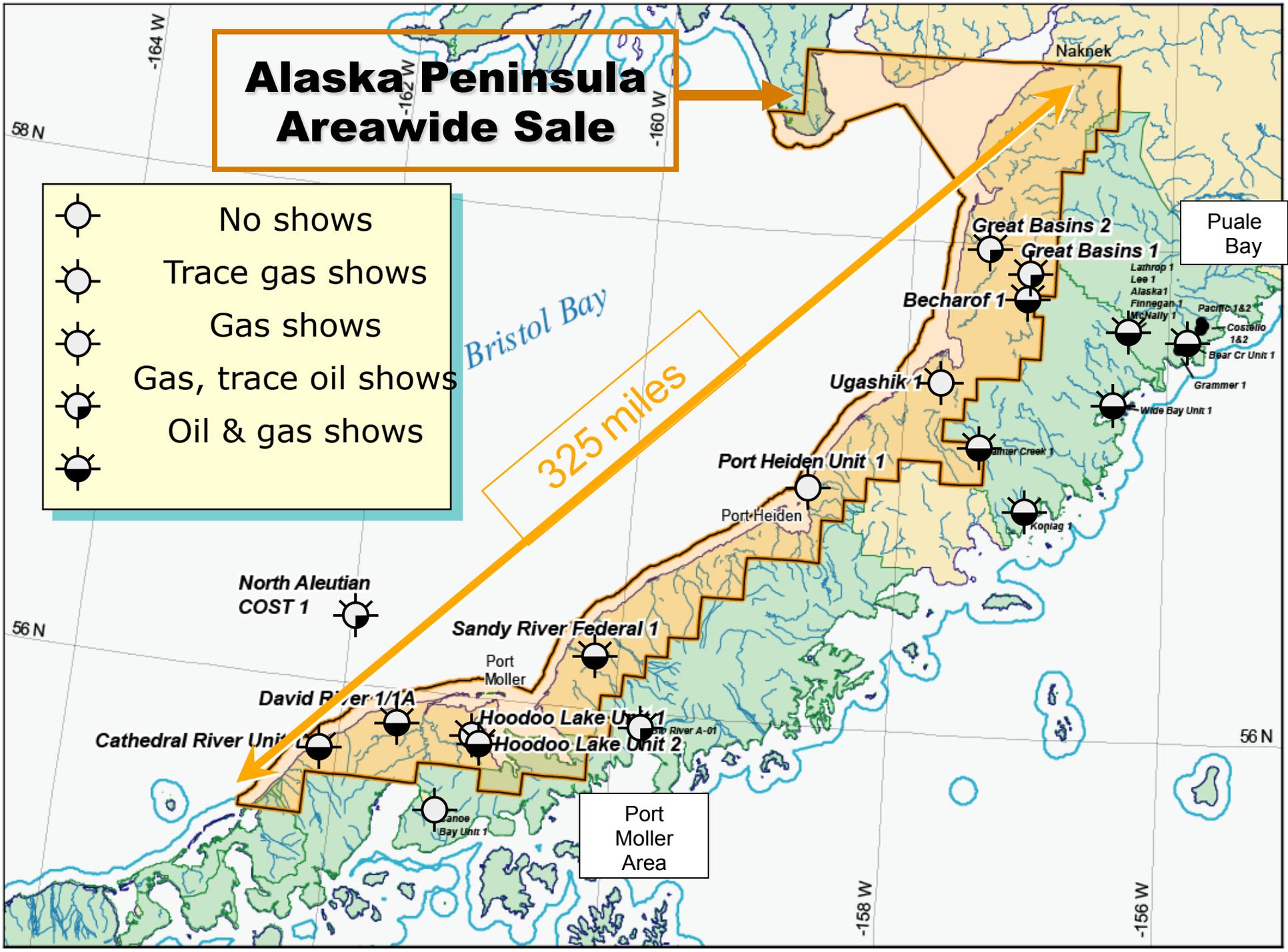
34 “warm to cool springs” (cooler than 122°F)

- 37 in the Aleutian Arc into Southcentral Alaska region
- 37 are mostly in the Central interior belt that extends from the Seward Peninsula to Circle Hot Springs
- 4 in the Wrangell Mountains
- 17 in Southeast Alaska

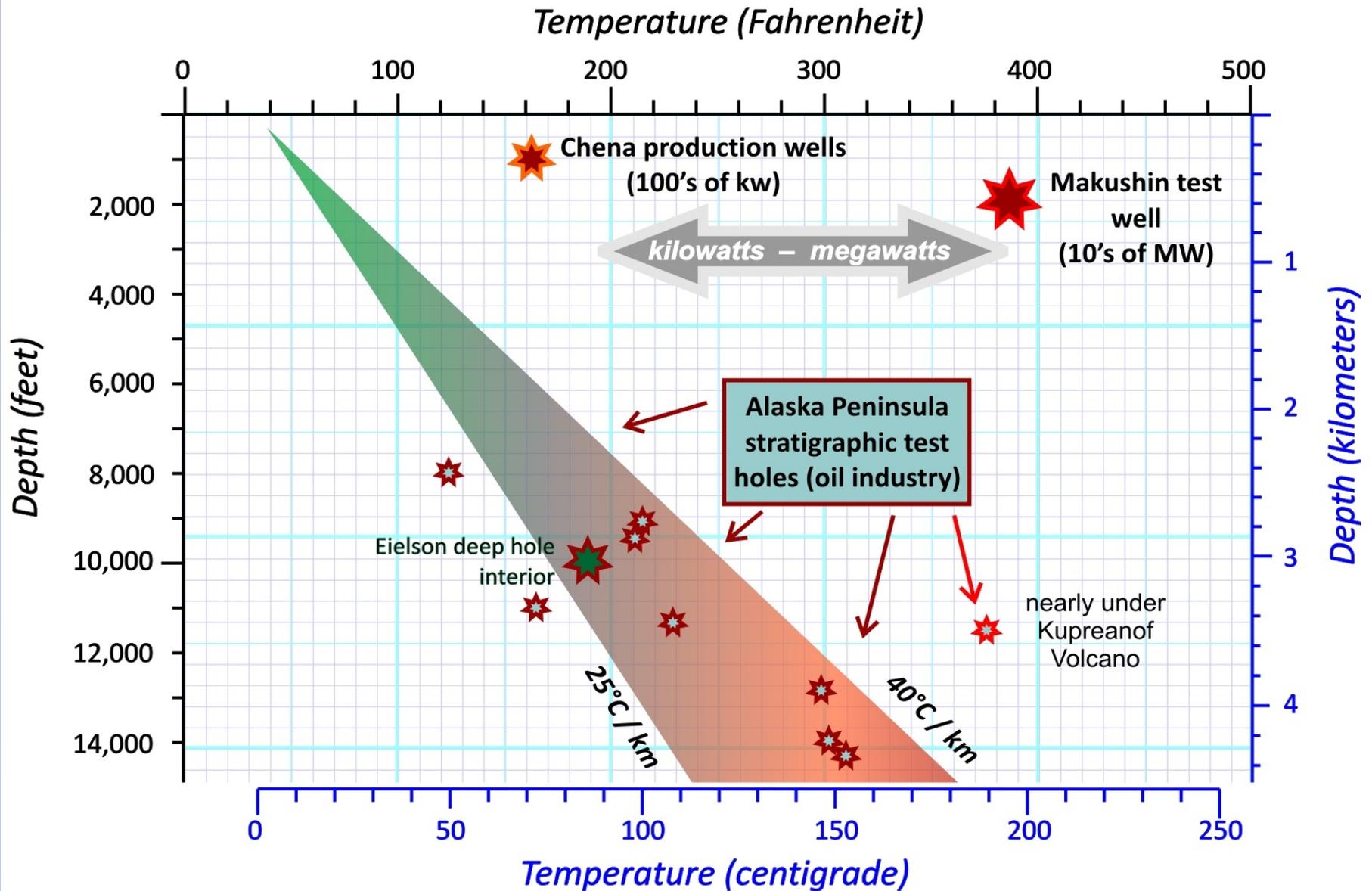
Alaska Peninsula Areawide Sale

| | |
|--|----------------------|
| | No shows |
| | Trace gas shows |
| | Gas shows |
| | Gas, trace oil shows |
| | Oil & gas shows |

325 miles



Comparison of known geothermal resource sites to normal geothermal gradient



Fundamental Ingredients of Useable Geothermal Energy

- ◆ Porosity and permeability for the migration of fluids

ALTERNATIVE ENERGY

Harvesting geothermal power

Heat generated from geothermal reservoirs deep in the earth can be harnessed to create steam and ultimately electricity.

How it works

- 1 Deep production well is dug to an underground steam reservoir
- 2 Pressurized steam is released and piped to a power plant, where its force turns a turbine
- 3 Turbine powers a generator that converts the rotational energy into electricity
- 4 After the water goes through power plant, it is injected back into the reservoir to maintain the resource

Geothermal energy

Three types of geothermal energy can be used to make electricity

GEOPRESSURIZED

Uses hot water (around 350°F/177°C) and hydraulic turbines

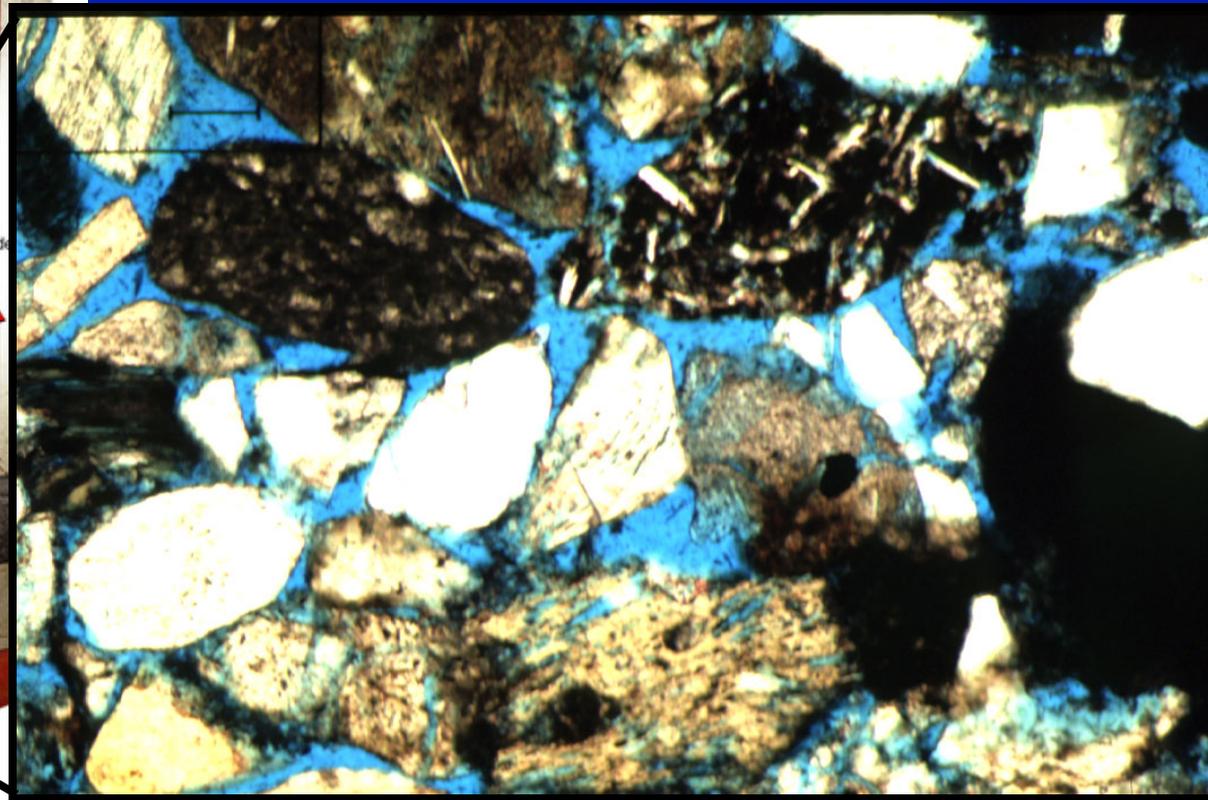
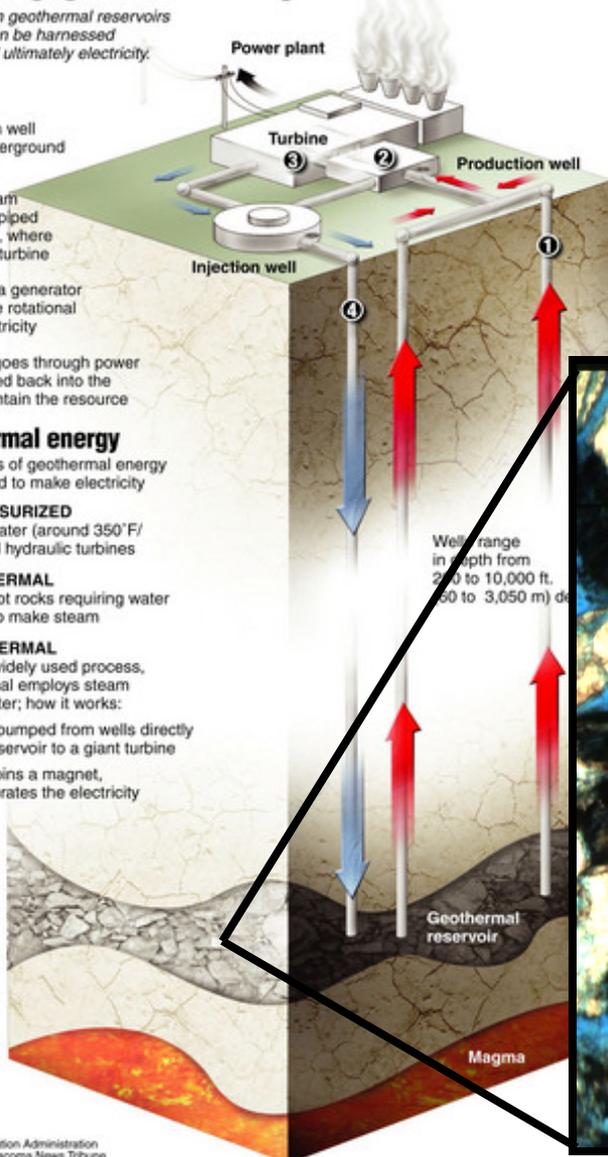
PETROTHERMAL

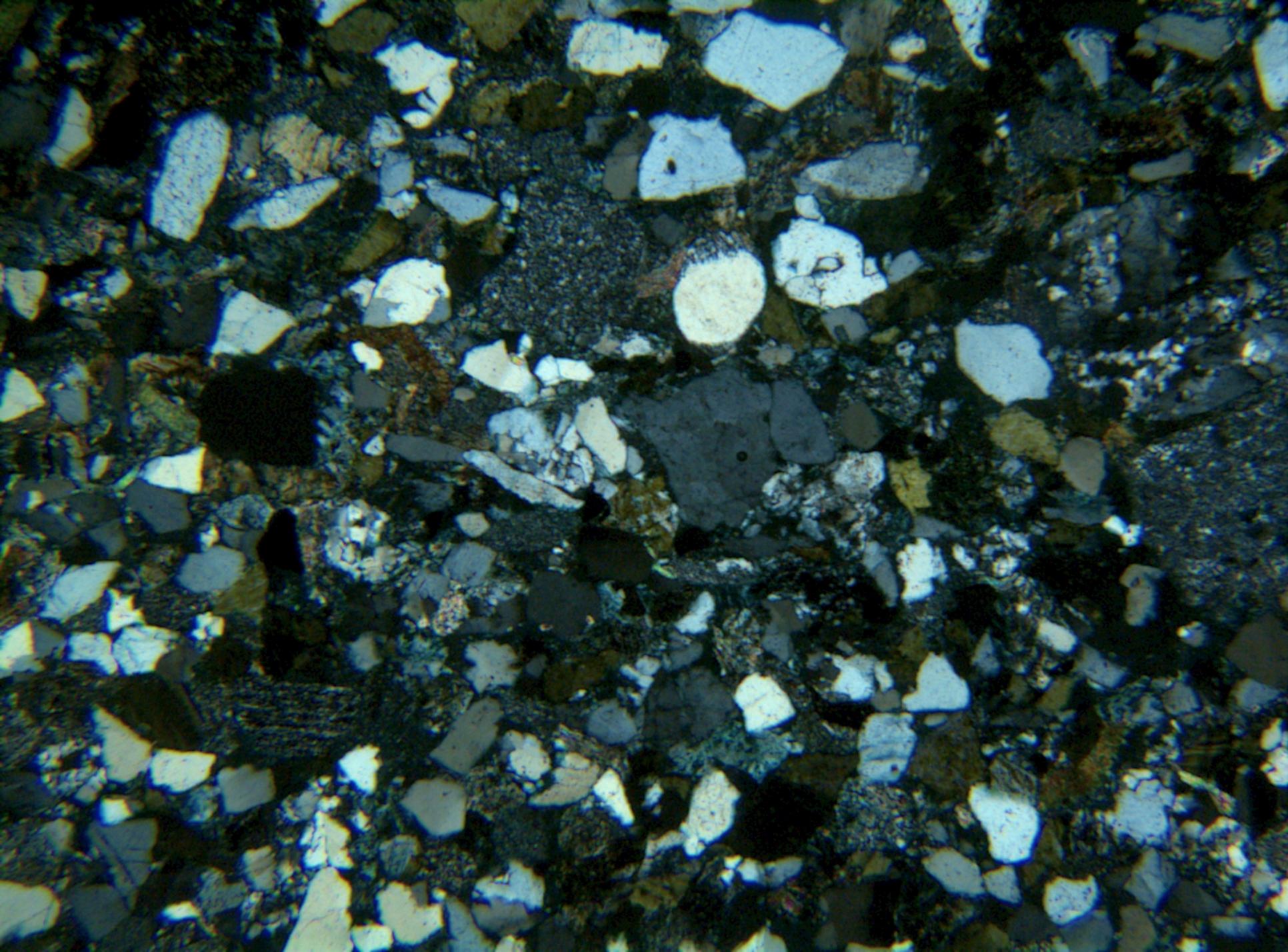
Uses dry hot rocks requiring water injections to make steam

HYDROTHERMAL

The most widely used process, hydrothermal employs steam and hot water; how it works:

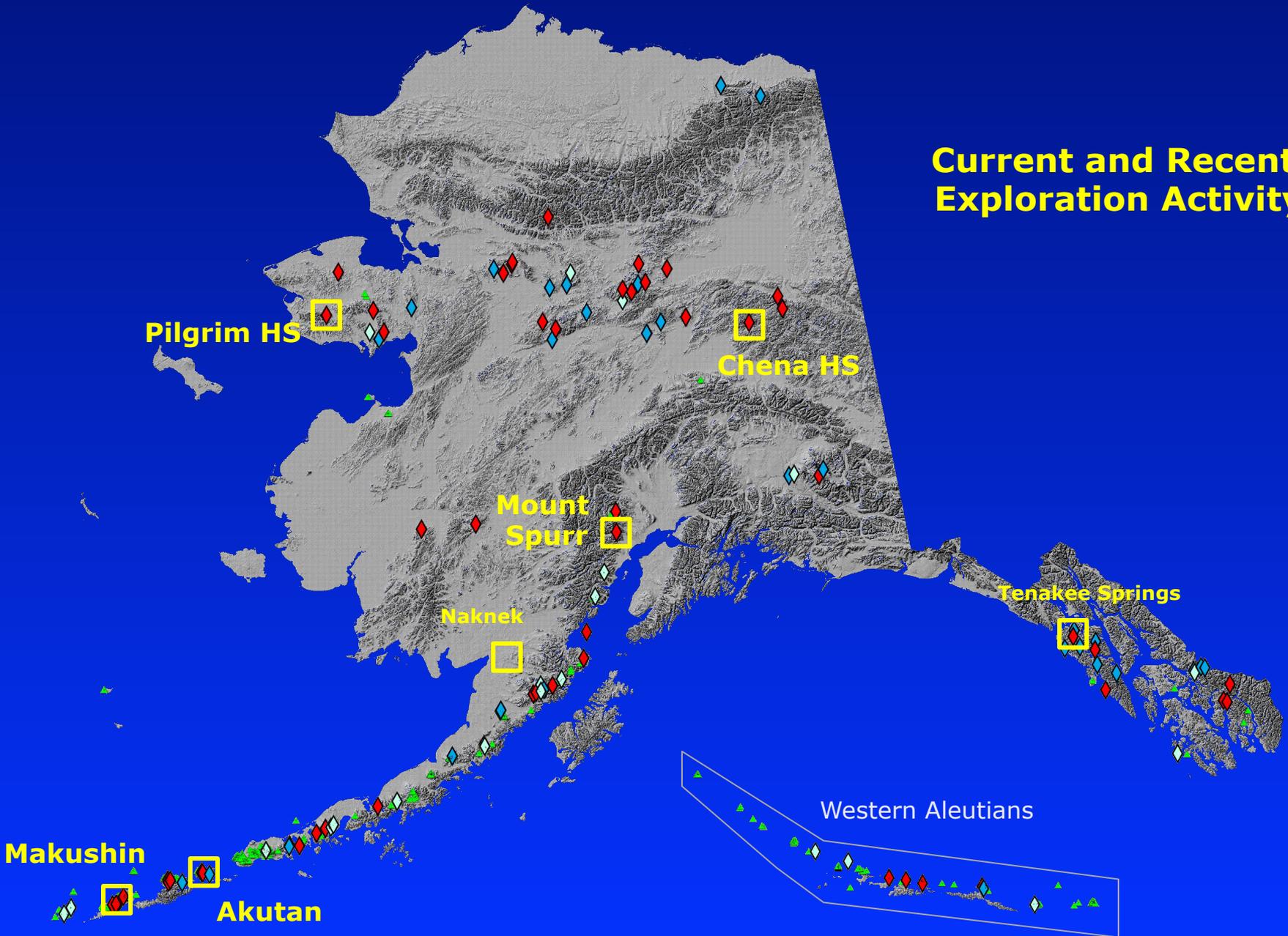
- Steam is pumped from wells directly from the reservoir to a giant turbine
- Turbine spins a magnet, which generates the electricity





Alaska Geothermal

Current and Recent Exploration Activity



Pilgrim Hot Springs

The Alaska Center for Energy and Power (ACEP) at the University of Alaska Fairbanks is conducting an evaluation of the Pilgrim Hot Springs area 60 miles north of Nome. This study has involved thermal imaging, geophysics and drilling. Hottest temperature in a well is 174°F.

This project is funded through a grant from the Alaska Energy Authority. During the summer of 2012, 3350 feet of exploration drilling was conducted, with the deepest well to 1296 ft. A magnetometer survey was also conducted.



ACEP is currently analyzing the results of their 2012 studies.



Photo from ACEP 2011 yearly progress report

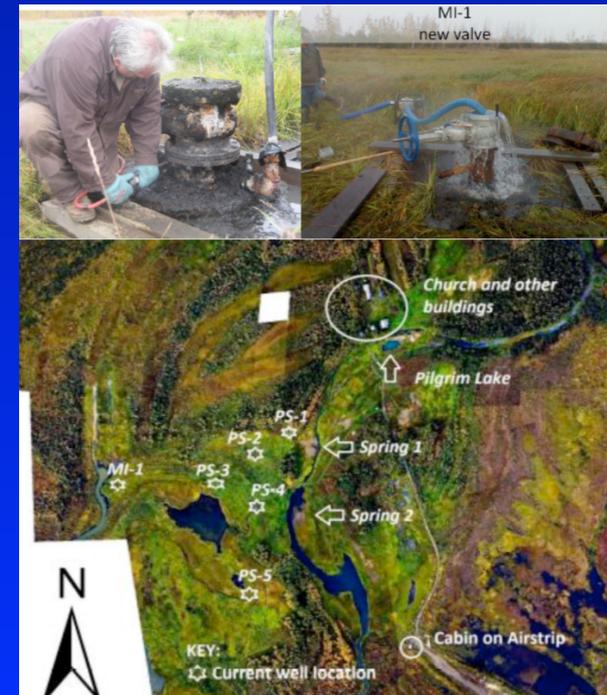


Figure from P. Crimp (AEA) presentation at 2011 BCEA conf.

Chena Hot Springs

From 2004 to 2007 under a USDOE grant, Chena Hot Springs conducted geothermal exploration that included drilling and pressure testing.

Chena Hot Springs has an avg. water temp. of 163°F

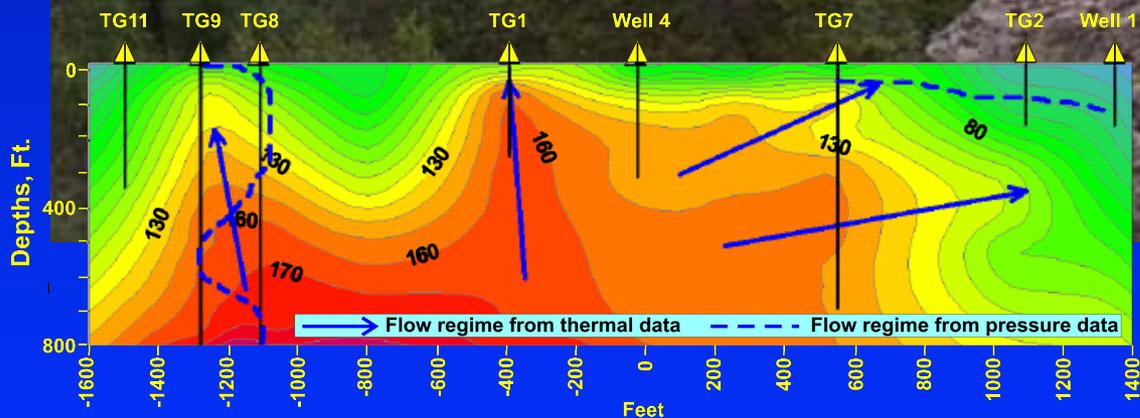


Figure and top photo from Holdmann and others (2007). Photo at right from Chena Hot Springs Resort website

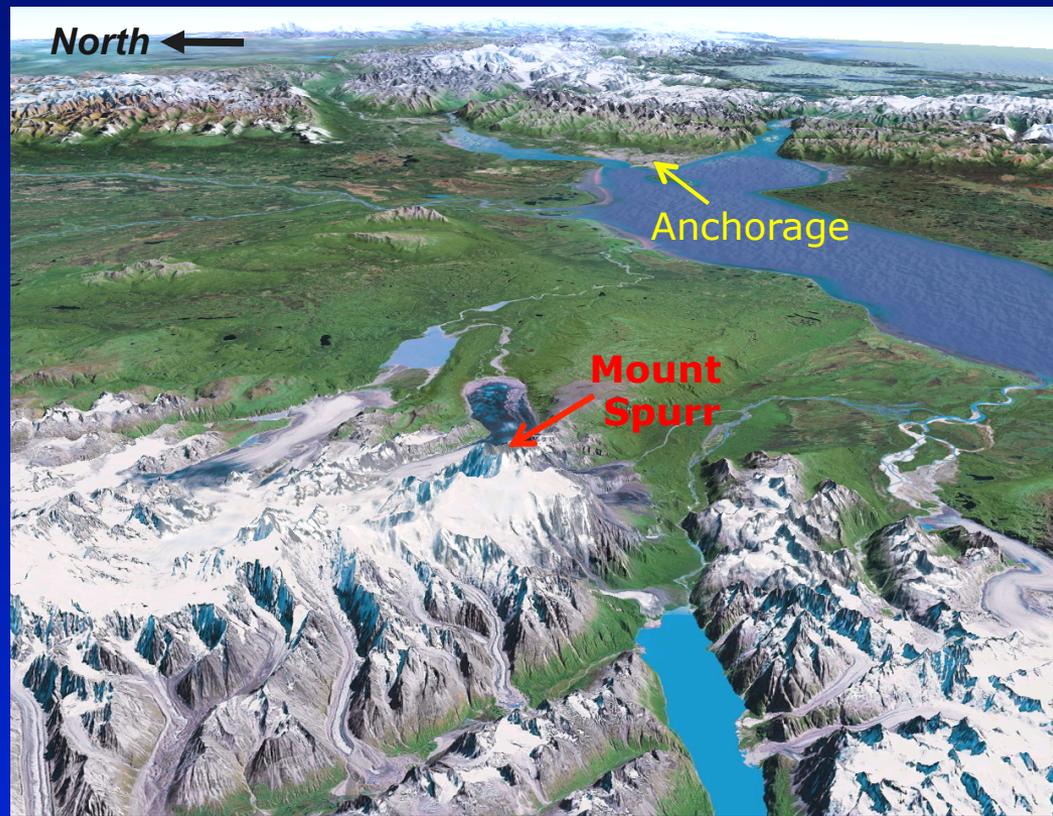


In 2006 a moderate temp Organic Rankin Cycle geothermal power plant was installed at Chena Hot Springs

Mount Spurr

During the fall of 2010, Ormat drilled a 4000 ft deep test well on the side of Mount Spurr, west of Anchorage. This project was funded in part by the AIDEA-Alaska Energy Authority.

The hottest springs on Mount Spurr are 104°F at Crater Peak.



Fumarole gas chemistry suggests much higher hydrothermal temperatures at depth (>400°F).

The results of the 2010 drilling were disappointing and Ormat is currently evaluating drilling a much deeper hole with a larger drill rig.

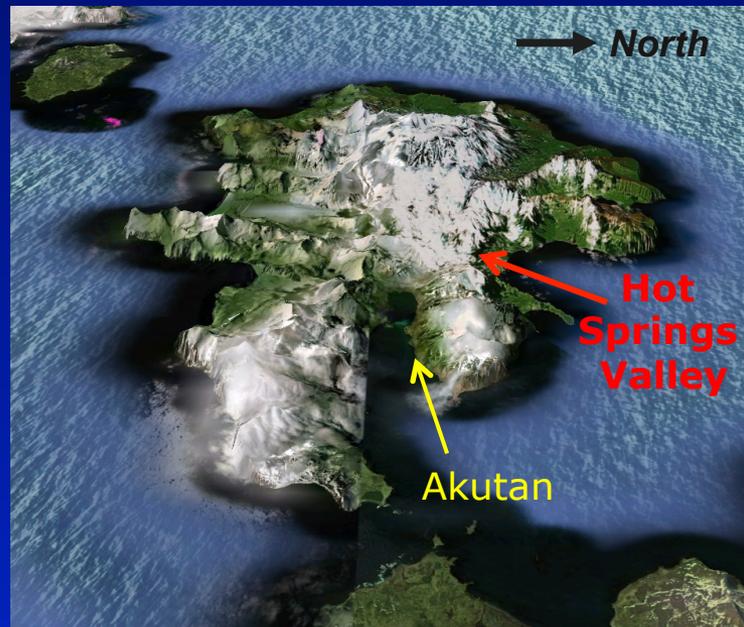


Photo of drilling site on the side of Mount Spurr. Photo from Ormat's July 24, 2011 presentation to Alaska House and Senate Resource Committees.

Akutan

Beginning in 2009, AIDEA-Alaska Energy Authority has funded exploration of Hot Springs Valley on Akutan island to evaluate the potential for geothermal development to provide energy to both the City of Akutan and nearby Trident food processing plant.

The hottest springs on Akutan are 184°F.



Fumaroles in Hot Springs Valley, Akutan



Photo by R. Koehler, DGGGS. View to south

2009-2010 geothermal exploration included geophysical field studies and core drilling to evaluate the geothermal potential of Hot Springs Valley. In 2012, geophysics and field mapping were conducted.



2010 drilling in Hot Springs Valley.

Photo from P. Crimp (AEA) presentation at 2011 BCEA conf.

Makushin – Dutch Harbor

In the 1980's the State of Alaska conducted a number of studies of the geothermal potential of the Makushin Volcano region, including nearby Geyser Bight.

This area is one of the most prospective for geothermal electrical power generation.

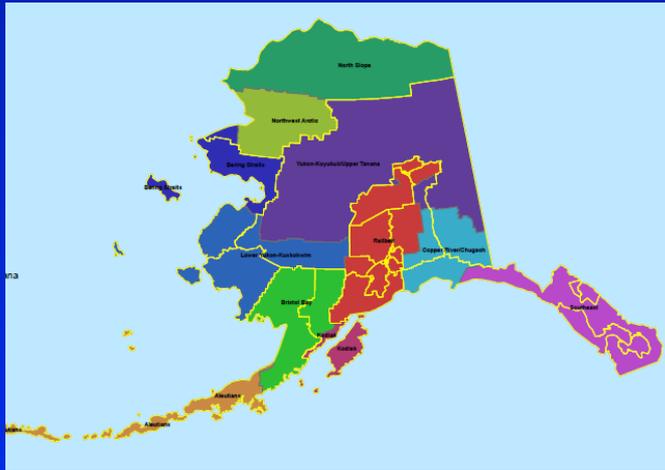


Photo by R. Motyka, DGGs.

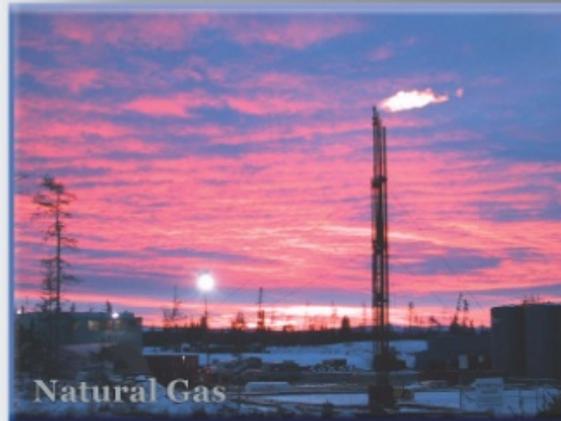
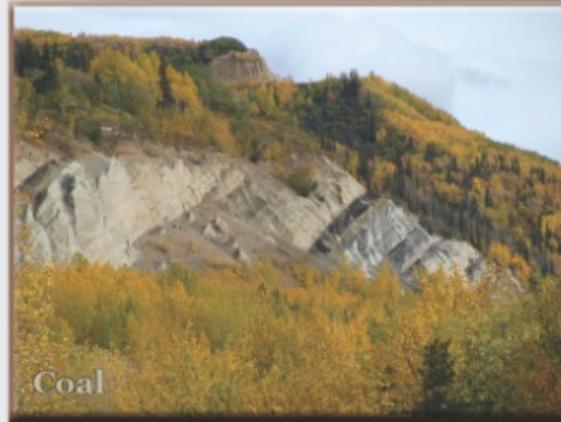
The area is still under consideration as a potential energy source for Dutch Harbor. The hottest temperature is 298°F in a test well.

Photo at left from the 1983 Makushin Valley geothermal test drilling.

Summary of available information on fossil fuel and geothermal energy in Alaska



Available for Download
www.dggs.alaska.gov



FOSSIL FUEL AND GEOTHERMAL ENERGY SOURCES FOR LOCAL USE IN ALASKA: Summary of Available Information

edited by
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DIVISION OF GEOLOGICAL &
GEOPHYSICAL SURVEYS

2012

STATE GEOTHERMAL DATA

<http://www.stategeothermaldata.org>



The American Association of State Geologists (AASG) created a Geothermal Data archiving and preservation project that is underway in all 50 states. This data will be archived into the National Geothermal Data System and accessible from this website.

Alaska is participating in this project that is sponsored by the U.S. Dept. of Energy under a grant award to the Arizona Geological Survey acting on behalf of the AASG

We are compiling and digitizing at-risk, legacy geothermal-relevant data and this data will be placed into the NGDS for access online. We are also creating a new geothermal map of Alaska.

STATE GEOTHERMAL DATA

HOME ABOUT DATA DELIVERY PROGRESS NEWS FORUMS MEDIA MEMBERS

State Geological Surveys in the U.S. have thousands of databases, directories, and 85,000+ geologic maps that collectively constitute a national geoscience data "treasure trove" for research and applications.

The State Geothermal Data project, organized by the Association of American State Geologists (AASG) with funding from the Department of Energy, will bring data from all 50 States into the National Geothermal Data System (NGDS). We are digitizing at-risk, legacy geothermal-relevant data and publishing existing digital data by exporting databases and directories to the network. A limited amount of new data in areas lacking precise information is also being collected.

The Association of American State Geologists (AASG) represents the State Geologists of the 50 United States and Puerto Rico. Founded in 1925, AASG exists to advance the science and practical application of geology and related earth sciences in the United States and its territories, commonwealths, and possessions.

Who's sending data?

News: [Arizona Geological Survey](#)
Latest: [New York](#)
Geology: [Washington](#)
Workshop: [Washington](#)
Courses: [Update](#)
Browse: [Data for the AASG State Geothermal Data Project](#)

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- [Upload Data](#)
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- [State Trademark](#)
- [Privacy](#)
- [Help/Support](#)

Deadlines

To submit your reports, go to [Washington State Data](#)

Current Progress Report Form Due
October 15, 2012
AASG Civil Service Survey Progress Report
October 15, 2012
Civil Service Survey Update Due
October 15, 2012

Forum Comments

Thank You!
December 8, 2011
From: H/Ranjan

Website Update
December 2, 2011
From: dave

Sponsored by the U.S. Department of Energy under award DE-00000460 to the Arizona Geological Survey acting on behalf of the Association of American State Geologists.

U.S. DEPARTMENT OF ENERGY
AZGS
AASG

Key Points

- ◆ **Geothermal heat, where technically and economically accessible, is an excellent form of sustainable energy**
- ◆ **Hydrothermal systems are the most common form of energy extraction from geothermal heat**
- ◆ **Having the complex geologic parameters necessary for a viable geothermal resource, all present at one location, is unique and relatively rare in nature**
- ◆ **Certain geologic settings are much more conducive to geothermal resource occurrence than others**
- ◆ **Alaska contains a number of potential and developable geothermal resources, but there are many physical technical, and economic hurdles that must be addressed**
- ◆ **New technologies that will help expand geothermal development into less favorable geology are on the horizon, and need extensive research, but significant hurdles remain**