Advanced Technology Branch | Advanced Energy Systems Section

GL04192

Hilo p. 351

Geopressured-Geothermal Systems

Theory behind:

Geopressured-Geothermal wells have 3 types of energy

1) Geothermal (heat)
2) Kinetic (H_2O under high pressure)
3) NATURAL GAS (in solution - i.e. in brine)

question: is solution saturated?

what is solubility of methane etc. in a brine?

p. 371 Large differences in salinities w/in geopressured zone due to interaction of H_2O w/ salt beds

Environmental problems assoc. w/ fluid disposal due to high salinity + conc. of toxic elements

p. 602 Drilling Requirements

Most obvious product = heat (hot H_2O)

Economic product = natural gas

Deep wells ≤ 20,000

≤ 400°F | 200°C

≤ 25,000 psi bottom hole pressure

≈ \$5 million

pressure > hydrostic i.e. geopressured

NATIONAL GEOTHERMAL REPORT

Vol 1, No 4
March 16, 1979

PLANS FOR GEOTHERMAL/GEOPRESSURE TESTING IN SOUTH LOUISIANA CONTINUE

Negotiations between the Department of Energy and the Louisiana Department of Natural Resources, Magma Gulf (Houston) and Gruy Federal (Houston) involving proposed geothermal/geopressure test drilling on three South Louisiana prospects are in final stages. If proposals submitted by the three groups are accepted by DOE for funding, the state agency will become primary contractor on the La Fourche Crossing Prospect, La Fourche Parish...Magma Gulf will head up operations planned for the Sweet Lake Prospect, Cameron Parish...and Gruy Federal will drill at a site slightly west of the Rockefeller Refuge Prospect, also in Cameron Parish. Proposals are expected to be submitted to DOE by the end of the month. Typical DOE expenditure for the drilling of one geopressure test is $6 million. The prospects include two of five areas recommended for further study by the Petroleum Engineering Department of Louisiana State University, Baton Rouge, as well as the Sweet Lake Prospect which was recommended by an independent consulting firm (NGR 2/23/79).

LSU, meanwhile, is continuing its assessment of geothermal resources in the state, in cooperation with the DOE. Preliminary studies show four areas on the Tuscaloosa Trend, south Louisiana, with possible high potential. They are the False River field area (covering parts of St. Landry, Pointe Coupee, East and West Baton Rouge parishes), the Judge Digby field area (Pointe Coupee), the Moncrief Big Cane area (St. Landry Parish), and the Rigolets field area (St. Bernard Parish). Because source data used in the preliminary study came primarily from petroleum operations, information was at times sketchy due to confidentiality. Therefore, the economics of the trend's resources is questionable at this time and more extensive data is required.

GRUY FEDERAL TO REENTER ABANDONED WELL IN ST MARY'S PARISH, LOUISIANA

Gruy Federal, under contract to the Department of Energy, will reenter a recently abandoned well in the East Franklin field area, St. Mary's Parish, Louisiana, and sample sands at about 15,686 ft to assess thermal reservoir potential. The well, 6-15s-10e, was plugged by Newhoff Oil & Gas and turned over to DOE, which termed it a "well of opportunity." The well is not in a designated thermal prospect area. It is north-northwest of the Atachafalaya Bay prospect and well to the west of the La Fourche Crossing prospect.

NORTHWEST IS TARGET FOR CONTINUED GEOTHERMAL RESOURCES ASSESSMENT

The U. S. Geological Survey, at the request of the Department of Energy, will conduct a five-year assessment of geothermal resource potential underlying the Cascade Mountain Range...an area extending from Mount Lassen, northern California, to the U. S.-Canada border in Washington. DOE has budgeted $1.5 million to the project for fiscal 1979; USGS will spend an estimated $1 million this year. According to USGS, the presence of important geothermal resources is suggested by the "extreme

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youth and wide extent of volcanism in the Range." However, surface expressions of hydrothermal activity in the study area are sparse.

Both agencies have been active in geothermal studies in the Mount Hood Prospect area in the Oregon Cascades for three to four years. Data obtained from a 4003 ft test well at Old Maid Flats, Clackamas County, indicates resource temperatures high enough for space heating, but too low for generation of electricity. Bottom hole temperature at the well was between 80 and 90 degrees Centigrade. For every kilometer drilled, temperature increased 65 degrees Centigrade.

DOE will drill additional holes on the mountain this year to depths of about 2000 ft. These observation wells will be used in temperature gradient studies and for hydrologic testing of a high underground water flow encountered during prior drilling in the area at about 800 ft. USGS believes such cool, near-surface groundwater serves to mask geothermal potential of the region. Elsewhere in the Cascades, USGS will complete the drilling of a second well located in the Caldera of the Newberry Crater, Oregon. The test, drilled to 1000 ft last year, will be reentered and drilled to 3000 ft this summer. Although a contract has not been negotiated, drilling should begin in June.

INDUSTRY BRIEFS

AN INDUSTRIAL GEOTHERMAL FORUM, sponsored by the Department of Energy, will be held Wednesday and Thursday, March 21-22, at the Executive Red Carpet Inn, Houston. Topics to be covered include geothermal/geopressure well and site selection, along with an overview and summarization of various aspects (legal, etc.) affecting geothermal exploration on the Gulf Coast. Meetings are scheduled from 9 a.m.-4 p.m. and are open to all interested parties.

LOCATION OF A THREE-DAY SYMPOSIUM on Geothermal Energy and its direct uses in Eastern United States, scheduled April 5-7, has been changed from Hot Springs, Virginia, to Roanoke. The event is sponsored by the Geothermal Resources Council, Davis, California (NGR 3/2/79).

Jones, P.H., 1977, Geopressured-Geothermal energy, Frontier Areas in Exploration Techniques in Campell, M.D. (ed), Geology of Alternate Energy Resources: Houston Geological Society, p. 215-250.

Geothermal-Geopressured-Frontier Areas + Exploration Techniques

- Favorable Areas
  1) Mississippi Salt Dome Basin
  2) Gulf Coast Salt Dome Basin

  } trailing continental margins
  i.e. former rifts (early Mesozoic)
  both floored w/ thick J salt beds
  sites of rapid sedimentation + salt diapirism

- Mississippi Rift Basin.
  Igneous activity widespread
  evidence in sedimentary pile of intense hydrothermal activity
  Geopressured Reservoir
  In 2ndary porosity in Smackover carbonates + ss
  Fluids = concentrated saline H_2O and/or diagnetic-metamorphic gases (CH_4, H_2S, CO_2)
  $T^\circ \approx$ 356-482°F (180-250°C)
  Depths ≈ 16,000-22,000' (4,880-6,710 m)
  Size of basin
  Much smaller + thinner (<1/2) than Gulf Coast

- Gulf Coast Salt Dome Basin
  Location-
  Gulf Coast Geosyncline + its gulfward margin
  Igneous Activity
  Inferred at depth by salt mobilization features + geotemperature regime of the noncarbonate clastic pile
  Reservoir Characteristics
  Compartmentalized (due to growth faults) sand bed aquifers w/ primary porosity (although reduced by some

T > 150° C (302°F)

Fluids = saline waters from ≤ 10,000 mg/l to > 200,000 mg/l

Diagenetic gases = CH_4 dominantly w/ significant CO_2

- Exploration Techniques

  Need to determine:

  1) geotemp. ⇒ isothermal maps
  2) geopressure ⇒ iso-fluid pressure maps
  3) geothermal fluid reservoir ⇒ maps
  4) geologic structure (esp. faults & folds) ⇒ map
  5) Salinity of formation waters ⇒ isosalinity maps

  Tools used:

  Seismic & borehole logging

  map fluid pressure

  structure mapping

  isothermal mapping (esp. borehole)

  Electric borehole

  isosalinity mapping

  sand-bed reservoir mapping

- Exploration History in Gulf Coast Salt Dome Basin

  Begun in 1974 by DOE (then ERDA)

- Exploration Problems

  Blind targets - no surface manifestations

  Most geophysical methods inapplicable

  Exploration procedure = exploration for groundwater

Resource Definition = Superheated g.w. in high-pressure aquifer system

- Mississippi & Gulf Coast Salt Dome Basins Framework
  1) Geothermal Regime due to igneous activity at depth
  2) Geopressuring Mechanism: metamorphic & diagenetic rxn ⇒ drastic increase in pore-fluid volumes & pressures

  Salt Dome mobilization requires T ≥ 300°C
  salt = excellent heat conductor
  salt domes conduct heat upwards & to surrounding seds
  transmits heat to shallow level seds
  derives heat from seds at depth
  Salt diapirs may be accompanied at depth by rising basalt

Growth Faults

Type locality = Gulf Coast geosyncline
Normal faults developed contemporaneously w/ deposition
i.e. as seds deposited across them
Characteristics:
bed thickness dramatically increases on down-thrown side
displacements on scale of 1000's of feet
die out downward as fault plane flattens

: orientation of fault plane
offset stratigraphy ⇒ compartmentalization of sand-bed aquifers
juxtaposition of sand beds against shale beds
sealing off of sand bed aquifers
these become geopressured w/ further burial
forms series of stacked sand bed aquifers
50-$500\ km^2$ & 10-100m thick

Thickness greatest adjacent to faults on downthrown side
decreases gulfward where SS → SH

Geopressuring Mechanism
Thermal diagenesis of montmorillonite ⇒ water (temp of ~~ 100-150°C)
this H_2O flushes thru the basin
Volume released ≈ 10-15% of volume of seds
H_2O flush = principal factor in generation + preservation of
geopressure

Division of Energy Technology D. Bona (Director) Salisbury (Deputy Director) = Energy Research

I. Hydrothermal Support Branch (Salisbury)
- Reservoir Assessment Section (Robert Gray)
1) Industry Coupled (Robert Gray) ESL
2) State Coupled (Gerald Brophy) ESL
3) Exploration Technology (Marshall Reed) ESL
4) Reservoir Engineering Research (Marshall Reed) LBL

- Hydrothermal Technology Section (Clifton McFarland)
1) Energy Conversion (Raymond La Sala)
2) Log Interpretation (Lawrence Ball) KASL + ESL
3) Log Instrumentation (Lawrence Ball) Sandia
4) Induced Seismicity } Ball + McFarland NVO
5) Induced Subsidence LBL
6) Geochemistry of Materials (Robert Reeber)

II. Direct Heat Applications Branch (Morris Skalka)
PON Program

III. Advanced Technology Branch (Clifton Carwile)

- Advanced Energy Systems Section
  1) Geopressured (Carwile) — USGS, LSU
  2) HDR (Allen Jelacic) — (LASL)
- Drilling and Stimulation Section (Arthur Follett) (Sandia)

IV. Projects Branch (Martin Sheve)

- Raft River — (EG+G)
- Well-Head Generator (Hawaii) — HIG / U of Hawaii

V. Program Coordination Branch (David Lombard)

- Environmental Analysis — LLL?
- Planning
- Staff Work

Division of Resource Application = Commercialization
Rudy Black = Director

Hydrothermal Support Branch | Reservoir Assessment Section

Reservoir Engineering (?)

p. 659 Reinjection Schemes at Cerro Prieto

Personnel: LBL

Advantages of Re-injecting:

1) disposal of brine
2) maintanance of reservoir pressure
   possible reduction of subsidence danger
3) sustaining production flow rates
4) enhances thermal extraction from reservoir of

Disadvantages:

1) Creates zone of relatively cold H_2O around each injection well
   May ultimately contaminate producing wells

Hydrothermal Support Branch | Reservoir Assessment Section

Reservoir Engineering (?)

p. 651

Injection Criteria for Geothermal Brines

Personnel: LLL

Injection of "spent" geothermal brine at Salton Sea
esp. injectability of suspended solids that are
produced during energy conversion process
Experimental Procedure: Flowed brine through
core samples & measure degradation of
permeability in the rock

Hydrothermal Support Branch | Reservoir Assessment Section

p.471 (LLL) Reservoir Engineering
Salton Sea

Well testing program near Geothermal Loop Experimental Facility

On April 16 and 17, the Earth Science Lab will host a two day technical workshop on geothermal commercialization. The symposium will consider the utilization of warm and hot water systems, the economics of direct heat and electric power, and technical aspects of flow testing and reservoir engineering. The lectures will be presented by staff members of EG&G who have worked extensively on DOE's commercialization program. The following is a preliminary agenda for the session:

APRIL 16, 17 TECHNICAL INTERCHANGE
MEETING AT UURI - ESL

1. DOE Programs: Regional & National Commercialization Support
2. Engineering Approach to Space Heating
   (temperatures needed, designs, efficiencies, trade-offs retrofit/new)
3. Industrial Process Direct Heat Applications
   (fluidize bed dryer, other experiments)
4. Heat Pumps
   (uses, efficiencies, limitations)
5. Hydrothermal Corrosion Problems & Considerations
6. Flow Testing & Reservoir Engineering
7. Electric Power System Designs
   (efficiencies, trade off, operating system)
8. Electric Power Economics
9. Direct Heat Economics
10. Policy Issues

Advanced Technology Branch / Drilling + Stimulation Section

ADVANCED Drilling

p. 001 Geothermal Well Completions

Personnel: SANDIA (Contract manager?)
Completion Technology Co. - Houston

Limitations of technology + equipment that has been adapted from petroleum industry
Unique requirements of geothermal downhole environment

ADVANCED Technology Branch / Drilling + Stimulation Section

ADVANCED Drilling

p.675 Geothermal Drilling + Completion Technology

SANDIA LAB = Managing contractor of this technology development
Technological deficiencies in current rotary drilling techniques
DOE / SANDIA GOALS:

1) Reduce well costs by 25% by 1982
2) " " " " 50% by 1986

Technology problems ⇒ high drilling costs ⇒ high costs of geothermal electricity
at present the cost of geothermal wells is 2 to 4 x > than conventional oil/gas wells

Present Drilling Barriers

High T° environment ⇒ adverse effects on drilling fluids, casing, cement, bits, elastomeric materials

Drilling Fluids = largest prob
- Lost circulation due to highly fractured reservoirs
- Conventional muds tend to gel at high T°
  - esp. when circulation stopped for tripping, logging, running casing ⇒ stuck tools, drill string failures
- Cementing probs due to drilling fluids
  - contamination of cement by fluids
    - gels which inhibit good cementing bonding
  - thickened mud channelizes behind casing
    - leaves uncemented areas ⇒ casing collapse

Bit Failure - esp. due to bearing failure
Elastomeric Materials
Current ones fail at 175 - 225°C
critical in rock bits, down-hole motors,
blow-out preventers, packers, Logging tools
Formation Effects
Extra #
predominance of fractured reservoirs
severe stress on drill string
hard / med-hard formations ⇒ slow penetration
Erosion + Corrosion
Drilling w/ Air:
doesn't damage formations + good penetration rate
rapid erosion of downhole equipment
Wet steam wells ⇒ erosion of casing
Hot, acid brines ⇒ erosion + corrosion of tools

DOE / SANDIA GOALS
1) Develop new drilling tools
2) Develop new drilling techniques
Subcontractors:
1) Research in high T° drilling fluids
Maurer Engineering, Baroid, U of OKLA.
2) Terra Tek - development of high T° bearings, seals, lubricants
3) Bit Development: Terra Tek, U of Missouri, Hydronautics

Advanced Technology Branch / Drilling + Stimulation Section

p. 419

Advanced Drilling - Improved Geothermal Drilling Fluids

Personnel:

Maurer Engineering, Houston
Sandia (?)
DOE - Carwile

Problems w/ conventional drilling muds at high T° (>150°C)
Degradation especially rapid T° > 200°C
" no existing drilling fluid that retains its required rheological and filtration control properties at > 250°C
Geothermal Drilling Fluid Problems:
- Mud Solidification (due to high T°, saline water + low pH)
- Lost Circulation
- Corrosion / Erosion

Have developed new drilling mud w/ properties good at 260°C
it's ≈ same cost as ordinary drilling muds

Economics
Use of new mud could reduce geothermal drilling costs by 10%
Reduce cost of power-on-line by 3-5%

Advanced Technology Branch / Drilling & Stimulation Section

p. 411

Advanced Drilling

Personnel: Maurer Engineering Inc., Houston, TX
LASL
DOE - Clifton Carwile

Maurer Eng. = Developers
high-T° 350°C advanced turbodrill
designed for improved directional drilling
allow drilling of several wells from 1 location
existing down-hole motors limited by high T°
LASL
This turbodrill developed in response to HDR program
will be tested there
Currently used Dyna-Drill hollow-rotor, fluid-cooled drills

Advanced Technology Branch | Drilling + Stimulation Section

Geothermal Well Technology Program - (Adv. Drilling?)

p.495

Continuous Chain Drill Bit Developments
SANDIA LAB

Fresh cutting surfaces cycled into place w/out removing the bit from the hole
"Fixed head bit testing"
Uses natural + synthetic diamonds "Stratapax"
in tungsten carbide matrix
Cutting surface attached to links of chain (5 links = 1 cutting surf.)
enough links to replace cutting surface 15 times before pulling rods
Drilling = conventional rotary
combo of bit load + rotation

Aovanced Technology Branch / Advanced Energy Systems Section

Hilo p.249

LASL's HDR Program

Basics of program:

1) Drilling of 2 deep holes into basement of
2) Connection of these holes by hydraulic fracturing
3) Circulating H_2O through system
4) Bringing thermal energy to system in form of super-heated liquid

"System operates in a closed-loop fashion (similar to the cooling system of many cars) and is characterized by minimal water loss, relatively low noise levels and few of the other problems associated w/ the development ~~of~~ and use of hydrothermal systems.

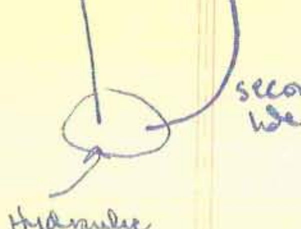
Hilo p.271

" Develop concept + technology to enable extraction of thermal energy from basement rock where there is no natural water in the high-T° formation".

on SW flank of the Valles Caldera

Hilo p.295 *

Project in existence for last 5 yrs. (studied since 1970)



Drill depths of 9610 ft + 10,053 ft.

bottom hole T° of ~~8~~ 197°C + 205°C respectively

Drilling problems: 2nd hole originally missed the fracture system assoc. w/ 1st hole

had to directionally drill

(still missed the fracture network)

... connected the 2 holes!

HDR cont

Ultimately had to re-drill (directionally) the 1st hole to give better flow

Power generating experiments:

> 5 MW(t?) power generated between 1/26/78-4/1/78

Future Plans

Drill a 3rd hole to a depth giving 250°C (expected depth ≈ 12,800')

2nd hole will then be extended to intersect this 3rd hole

Expected Power generation

> 50 MW(t) in 1980

(ERDA)

1977

HDR

Two Categories of HDR

1) igneous-related = "high-grade deposits"

heat transferred to surrounding crust from magma bodies

2) HDR in crust

heat transferred by conduction from earth's interior

heat source = 1) unusually warm upper mantle

2) local internal sources (radiogenic / metamorphic i.e. exothermal rxns)

Resource Assessment conterminous US

74,000 quads of heat stored in igneous HDR

at depths < 10 km

w/ T° > 150° C

Western US

6.3×10^6 quads

T > 150°C

≈ 1×10^7 quads in conterminous US

N.B. * These figures do not assess extraction or conversion efficiencies.

no extraction technology or economic considerations made

Association of HDR w/ hydrothermal convective systems

in time + space

evolves w/ time

hydrothermal systems used as exploration targets?

Current HDR exploration sites Assoc. w/ young silicic volcanic centers

Valles Caldera, Coso, Marysville. Mt

Exploration Technique

1) Identification of a geothermal system
    a) by hot springs, fumaroles etc. and/or
    b) by assoc. w/ young volcanic system
2) Identification/Delineation of the hydrothermal portion of the system
    the remainder could be HDR

Exploration Scheme

1) Site selection - review of existing data
2) Acquire new surface geology + geophysics data
    select drill sites
3) Develop pre-drilling model
4) Heat-flow survey, slim-hole drilling (i.e. less expensive than production holes)
    confirm pre-drilling models
5) Refine model
6) Deep drilling, data analysis + evaluation

Most of program relies on drilling Expensive! Need to develop new drilling equip + techniques

Goals of Current HDR projects

1) Valles Caldera - Fenton, Hill (LASL)
    demonstrate twin hole + hydraulic fracture technique of HDR extraction
2) Marysville, Mt. (Battelle NW LAB) - drilling program to extract geothermal energy from shallow, dry rx - not to assess the resource
    under NSF - RANN
3) Coso - develop slim-hole drilling techniques for resource assessment + determine HDR potential of the site
    as of 1977, still in initial stages, w/ no deep drilling yet

N.B. - only Coso project involves actual resource assessment

HDR Geothermal Resource Definition:

"Heat stored in rx w/in 10 km of the surface from which energy cannot be economically produced by natural hot water or steam"

Favorable geologic areas of:

1) recent or Quaternary volcanism
2) current or recent hydrothermal activity
3) high regional heat flow
4) current or recent tectonic activity

see Spring 1976 AGU Mtg. Wash. D.C. program

Participants

1) Fenton Hill

LASL ± USGS, Slemmons at UNR

2) Marysville, Mt.

BATTELLE NW LABORATORY ± Blackwell at SMU

initially funded by DAVID Lombard at NSF

program transferred to ERDA when Lombard NSF → ERDA

3) Coso Area

USGS

BATTELLE PACIFIC NW LABS

China LAKE NAVAL WEAPONS Center

Univ. Texas at Dallas

"Neither specific techniques nor an explicit exploration rationale exists for HDR" p.78

p.579

Hydrothermal Support Branch / Hydrothermal Technology Section

Geochemistry of Materials

Chemical Characterization of Gases + Volatile Heavy Metals
in Geothermal Effluents

Personnel: Battelle - Pacific NW Labs

NSF + DOE funding

Areas of study:
The Geysers
Cerro Prieto
Baja
RR
Tigre Lagoon, LA.
Imperial Valley

Hydrothermal Technology Section?

Energy Conversion (?)

p.441

Heat Transfer Technology
Personnel: Oak Ridge Natl Lab (Tenn.)
Union Carbide Corp (?)

Developement of low-cost, efficient heat exchangers
Waste heat rejection

Hydrothermal Technology Section | Hydrothermal Support Branch

(Hilo p. 125) Induced Subsidence + Seismicity in the Imperial Valley
LLL contract

Major goal = develop techniques to distinguish between natural + induced seismicity

Augment USGS seismograph network

Hydrothermal Support Branch | Hydrothermal Technology Section

Logging Instrumentation

p. 679

Personnel: SANDIA = managing contractor

Current technology:

instrumentation for making geothermal borehole measurements limited to ≈ 180°C w/ existing logging equipment

GOALS:

develop instrumentation good to 275° C in pressures ≤ 7000 psi
Later to refine to 350° C + 20,000 psi

working closely w/ geothermal producers, logging service companies

Tools needed:

T°, flow rate, high resolution down-hole pressure, caliper + fracture mapping sondes

Workshop Paan

Current Programs
1. Exploration Architecture Ward/Wright — Moore Ross

2. Resource Definition/ Location /Warm Water Assessment/ Foley

3. Characteristics of High Temperature Geothermal Systems - Moore

4. Application of Geochemistry to exploration: Case Study examples-Geysers vs. Roosevelt - Christensen

5. Geology of a hot water resource-Case Study of Roosevelt - Moore

6. Hydrology of a Geothermal System-Case Study of Roosevelt - Foley

7. Estimation of subsurface geothermal characteristics temperature and fluid compostion - Christensen - Foley

Overview of geologic exploration techniques

Overview of geochemical exploration techniques

1. Overview of geophysical exploration Techniques - Ross

2. Geology of a Geothermal System-Case Study of Cove Fort - Moore

3. Geopyshical Exploration Techniques- Case Study of Cove Fort Ross

4. Downhole logging techniques-Case Study of Roosevelt/Cove Fort - Ross

5. Tectonic overview of Geothermal Systems/Resurgent Calderas Christensen Moore

Copies of Illustrations
Short abstracts

Hot dry with geopressured
↓
east Coast
↓
Cascades

Joe Moore
Dave Foley
Howard Ross
Odin Christensen

Current Projects
ESL Projects
DOE Projects non-ESL
East Coast - Costain's
HDR
Geopress -
Well Log Interp
" " Instrumentation
Induced Seismicity
Subsidence
Reservoir Eng , Expl & Assess Tech

27 Feb 79

current programs

res defn + assmt (location, too)
 L + 5 geol types
 aimed toward favorable short terms
 heat in rk + heat transfer

} Workgroup 1, expanded

geochem - fluid,
 rk + soil (trace, etc.)
 isotope (stable + dating)
 ~~[illegible]~~.

geophys techniques

hydrology (RHS?)

RHS - a Cove Fort all facets of case studys
 (Coso geophys, too)
 (Geysers)

Dn hole logging (temp fluctuations)

Future aspects: sites for ~~[illegible]~~ future res
 HDR
 Geopres
 E. Coast
 Cascades

Larry Burdge
John Morfett

ID		Direct Heat and Commercialization	Electric
Maggie		Bob Schultz	Jack Ramsthaler
Wood	(D)	Dick Smidt (Raft DH)	Tom Lawford*
Mink	(C)	Joe Hanny	Ferrol Simpson
Nichols	(D)	Norm Stanley	Harold Barton, Construction, Eng.
Chappell	(D&C)	Gus Gertsch	Judd Whitbeck
Griffith	(D)	Joe Keller (Raft DH)	Gary Mallar PR Oper.
Knowles	(D)	Ed DiBello	Dick Miller - corrosion
Prestwich	(C)	Lunis	
	(D)	John Strawn	
	(D)	Jim Close	
	(D)	Frank Childs	
	(D)	Ivor Engen	
	(D)	Lloyd Donavan	

Res. Eng.

Bob Stiger
Max Dolence*
Jackie Sullivan
Dennis Goldman*
Dave Allman*
Sue Spencer
Tony Allen

1 BASICS

2 Reservoir TESTING

LARRY BURDGE

Direct Heat	Electric	Res. ENG
Bob Schultz	JACK Ramsthaler	Bob Steiger
		MAX Dolence
Joe Hanny		
Gus Gertsch		
Ed Di Belo		

PADMASTER® / Made in U.S.A.

TO: Joe

2/27/79

FROM: Debbie

RE: Current ESL Projects

- Industry Coupled
- State Coupled
- Geothermal Sample Library
- User Assistance
- Geothermal Data Base
- Geologic Support
- Geochemical Support
- Geophysical Support
- Induced Seismicity
- Characterization of Hole 9-1 (Roosevelt)
- Exploration Technology
- Other (non-DOE)
  U.N.

SURVEYS OF EAST COAST GEOTHERMAL POTENTIAL ENERGY MARKETS HAVE BEEN MADE FOR DELMARVA Peninsula, southeastern New Jersey, Norfolk area of tidewater Virginia and eastern North Carolina. In case you're wondering, guess what may be best prospect for deep geothermal well being drilled near Crisfield, MD (GR,1Feb'79,4) by DOE contractor Gruy Federal? Chicken farming, says William J. Toth of Johns Hopkins Univ. Applied Physics Lab, who prepared market surveys for DOE, and reported on them at 6th Energy Technology Conference this week at Washington Sheraton Park Hotel.

APL's market study is part of DOE's overall East Coast geothermal development program that includes Gruy's drilling of 50 shallow gradient wells and Crisfield test well, also effort by John Costain of Virginia Polytechnic Institute to correlate gradient and other geological data to identify promising resource areas. Better than 500 industrial firms have been canvassed by Toth and his APL associates and about 175 co.'s are identified as having process heat requirements geothermal could satisfy. Toth also has data for space and water heating requirements in residential, commercial and military sectors and for crop drying and space heating in agricultural sector.

GEOTHERMAL FOR BIRDS. Delmarva is one of the largest poultry-producing areas in the U.S. and has largest space heating requirement out of all four areas agricultural applications. "For example, on the Delmarva Peninsula, poultry house capacity exceeds 82,000,000 chickens and production exceeds 380,000,000 chickens per yr. Annual heating bills for the 6300 broiler houses exceed $6 million for well over one trillion (10^{12}) Btu. However, because of the wide distribution of poultry houses in rural areas, only a fraction of this energy can be economically supplied by geothermal resources, i.e. where such resources co-exist with large concentrations of poultry houses. Again, it would probably be most economical to have this use tied into a dual-purpose district heating system," said Toth.

Again, Toth pointed out sometime problem of matching industrial market with resource locations. A nominal geothermal production well was defined as one that produces 500 gpm of water whose temperature is reduced 50 F by extraction of thermal energy, producing about 10^{11} Btu per yr. About half of industrial market for Delmarva is related to poultry industry, largest single geothermally compatible industry in any of four areas surveyed.

Toth found most likely prospects for geothermal heat would be industry, but that not all SIC (Standard Industrial Classification) industries could use special geothermal heat not expected to exceed 250 F. His screening identified six industries having process heat requirements below 250 F: foods and kindred products, textiles, tobacco products, lumber and wood products, pulp and paper, and chemicals. Foods and lumber turned out to be largest and best suited, and within foods the poultry processing with large space heating, feed drying, steam cleaning requirements along with canning and crab processing had big heat-consuming activities. Poultry and canning have the concentration to use entire output of one or more geothermal wells. But large no. of crab processing plants are often small concerns requiring steam at 250 to 260 F, are scattered, and therefore not very attractive candidates. With market studies finished in these four geographic areas, Toth and APL this Spring will extend resource areas to South Carolina and Georgia.

IN INDUSTRY

BECHTEL WON $4 MILLION PLUS DESIGN ENGINEERING CONTRACT FOR VALLES CALDERA 50 MW DEMonstration geothermal plant, first large flash steam plant in U.S. being built

Projects Branch
Hawaii Well-Head Generator

- Hawaii Geothermal Wellhead Generator Project (Hilo Trans p. 95)
  U of Hawaii | HIG | Hawaii Geothermal Project (HGP)
  (Charles Helsley)

Exploratory geothermal well - island of Hawaii
  wellhead generator ⇒ demonstrate feasibility of using geothermal energy from area of active volcanism
  >90% Hawaii's energy from imported oil
Geothermal Drilling History on Island of Hawaii
  started in early 1960's in the Puna Area
  1976 - completion of well HGP-A (east rift of Kilauea volcano)
    bottom hole T° 358°C at depth of 1966 m
    steam quality 62%
    hot-H_2O reservoir in fractured basalt
  5-MWe generator planned for 1979
    FY 79 budget = $1.3 million
Assessment of power plant siting in volcanically active areas

Program Coordination Branch

p.523 Environmental Analysis

Geothermal Overview Project
LLL= Managing contractor

Early identification of environmental assessment needs for KGRA's
already implemented at RR INEL
Roosevelt - UURI
Geysers - LLL
Gulf Region - LSU + Univ Tx-Austin

Environmental Issues:
air quality
ecosystem quality
noise
geologic effects
H_2O quality
socioeconomic + health effects
Workshop approach

Advanced Technology Branch ?

MAGMA Energy Research Project

SANDIA LAB

Scientific feasibility of extracting energy directly from deeply
buried, circulating magma
Methods of energy extraction:
insertion of heat exchanger into magma ⇒ surface
conversion to electric power
use reducing nature of magma to produce
transportable fuels - Hydrogen / methane

Molten LAVA Sensing Experiment
Kilauea Iki LAVA Lake

Direct Heat Applications Branch

Hilo p. 219 Mt. Hood (PON?)

DOE-funded

in coop w/ USGS, DOGAMI, FS

Assess geothermal potential of Mt. Hood ⇒

stimulation of commercial exploration of young strato volcanoes for geothermal energy

Proximity to Portland (60 mi.)

LBL did MT survey

4003' test well at Old Maid Flats, Clackamas County

T° of 80-90°C

gradient = 65°C/km

DOE will drill additional holes this year to ≈ 2000'

1) thermal gradient tests

2) hydrologic tests

high flow cold-water aquifer at ≈ 800' may be masking geothermal potential of the region

Other Cascade Programs

1) Drilling at Newberry Caldera

already to 1000'

will reenter ⇒ 3000'