sea. Though perched water was a more persistent source,
times was not available.
toric time we have been in a period of relatively high
on. All of the swamp, lake, spring run, and sinkhole de-
, that severe aridity existed throughout the peninsula
atic intervals that in other temperate regions represent
rvals. There is no evidence of significant temperate
eninsular Florida during the last 16,000 years. The changes
n the pattern and frequency of precipitation from hurri-
mer thunder storms and frontal systems.
graphic and paleontological data from Silver Run, Ichatuck-
aloosahachee River, Devils Den Sinkhole, Warm Mineral
ittle Salt Springs and from lakes and peat bogs of Florida
iewed in relation to establishing a chronology of hydro-
nts.

TECTONICS AT A GREENSTONE-GNEISS BOUNDARY, LAKE WINNIPEG

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Island, L. Winnipeg, a "greenstone" felsic volcanic pile with
mafic and intermediate rocks, is overlain by volcanogenic
s, arkosic sandstones and conglomerates, spinifex-textured
bodies and cherts. The pile is overturned and dips steeply
It is separated from a granite/gneiss terrane to the east,
zircon U-Pb; Krogh and Davies), by a narrow zone of strongly
quartz-diorite and tonalite gneiss (3.0 and 2.9 b.y.), which
ded by granites (2.7 b.y.); metasediments, and intrusions re-
the volcanic pile, are recognized. This zone trends NNW-SSE
ne of intense differential vertical movement, characterized by
tally plunging, upright, isoclinal folds, which invariably
te that the granite/gneiss has moved upwards relative to the green-
Pervasive kink- and box-folds about steeply westward plunging
associated structures, overprint the isoclinal folds. The
rance of one set of kinks, and a general right-lateral slip
t that compression on a NNE-SSW axis caused bend-glide folding
earlier NNW-SSE foliation. The gneiss zone is, in part, a
of the crystalline basement to the greenstones, at the margin
wholly remobilized granite/gneiss terrane.
e events here, the symmetry, lack of N-S trends, predominance of
ends, and abundance of triple junctions in the greenstone belts
northwestern Superior Province suggest that the belts may be
zones of interference between cells of Kenoran granite/gneiss
through a general stress field whose major horizontal compressive
s N-S to NNE-SSW. The hypothesis can be checked by the structural
e.

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METHOD FOR EXTRACTING ENERGY FROM "DRY" GEOTHERMAL RESERVOIRS

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ned over the developing energy crisis, a small group at the Los
s Scientific Laboratory has been working for the past two years

on the development of a practical, yet economical and environmentally acceptable, method of extracting thermal energy from the numerous regions of the earth's crust containing hot--but essentially dry--[illegible] at moderate depths. Temperatures in excess of 160°C at depths less than 6 km appear to be suitable for present development.

In this man-made system for extracting geothermal energy, the heat contained in an accessible body of hot rock would be convected to the surface by the flow of pressurized water, not unlike natural geothermal systems. As proposed, a large fractured region of hot rock--created by hydraulic fracturing--would be interconnected to a heat exchanger (or heat engine) at the surface by a pair of drilled holes, forming a closed convective circulation loop. The water in the [illegible] loop would be maintained as a liquid throughout by pressurization at the surface, greatly increasing the amount of heat that can be removed for a given pair of holes, when compared to the flow of steam.

Preliminary experiments and analyses indicate that thermal stresses resulting from the cooling of the hot rock in such a reservoir may enlarge the initial fracture system so rapidly that its useful lifetime will be greatly extended beyond the planned 10 to 15 years provided by the original reservoir.

ORDERING OF TRANSITION METAL CATIONS IN OLIVINES

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A number of recent X-ray and Mössbauer studies of Fe-Mg olivines have shown that the larger cation, Fe^{2+}, has a slight preference for the smaller and more distorted of the two nonequivalent octahedral sites, M1 ($K_D^* = 1.00-1.30$). In contrast, Fe-Mg pyroxenes exhibit strong ordering in the opposite sense with Fe^{2+} preferentially occupying the larger and more distorted M2 octahedral site ($K_D^* = 0.03-0.20$). In order to better understand the factors controlling site preferences of transition metal cations such as Fe(d^6), Co(d^7), and Ni(d^8) in olivines and pyroxenes we have anisotropically refined the structure of $Ni_{1.03}Mg_{0.97}SiO_4$($\underline{a}$=4.740, $\underline{b}$=10.166, $\underline{c}$=5.944A) to R=0.029. Least squares site refinement indicates significant ordering of Ni on M1 (0.767 Ni + 0.233 Mg $\sigma = \pm 0.002$) and of Mg on M2 (0.737 Mg + 0.263 Ni)($K_D^* = 9.$[illegible]. This amount of Ni-Mg ordering is rather surprising in view of the small size difference (0.03A) between the two cations and suggests that crystal field effects strongly favor Ni in the M1 site of olivine in agreement with the prediction of Burns (1970). Comparison of X-ray and optical spectral data for Fe-Mg and Ni-Mg olivines and pyroxenes indicates that site preferences of Fe, Co, Ni and Mg depend on a balance between (1) site distortion, (2) cation/site size and (3) the effect of M-O distance on CFSE. Only the site distortion criterion predicts the observed cation ordering in all cases. The fact that the oxygen ligands surrounding the M1 site of pyroxenes have a net negative charge, whereas those surrounding M2 are neutral on the average, is an additional effect which may enhance the ordering of transition metal cations on the M2 site of pyroxenes. $^*K_D = [Mg(M2)Tr(M1)] / [Mg(M1)Tr(M2)]$

NCLUSIONS AND COMPOSITION OF PYRITES FROM F
TERED ROCKS OF THE BOULDER BATHOLITH, MONT

low, Arthur H., Park, Won C., and Kurz, S
eology, Boston University, Boston, Mass., 0

es from throughout the Boulder batholith (in
district) have been studied microscopicall
Micron-sized inclusions of sulfides, oxid
ting a variety of textural relationships, w
es. These inclusions occur either as single
s of two or more minerals. More inclusions
rothermally altered rocks as opposed to una
st common sulfide inclusions consist of cha
opyrite or cubanite with pyrrhotite, and cha
awite plus or minus pyrrhotite. We believe
a phase captured during pyrite growth. Th
positional field of cubanite solid solutio
dropped, chalcopyrite or sulfur-poor cubani
awite formed. Annealing experiments indica
about 325 °C.

About 500 probe analyses of pyrites and cha
ade for Fe, S, Ni, Co, and Cu. Pyrite comp
vary between x = 1.88 to 2.11. Pyrites fr
red rocks tend to have more sulfur and less i
tered rocks. The Ni, Co, and Cu contents of
ving average values: Ni - 0.15 weight % (ra
.51% (range none to 5.7%), and Cu - 0.16% (
opyrite inclusions are slightly iron-poor an
values are: Ni - 0.14% (range 0.008 to 0.22%
ge 0.1 to 1.3%).

-Sr^{87} ANALYSES OF ULTRAMAFIC ROCKS, BASAL GNE
AY

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med olivine-chlorite-tremolite vein within a
zone of the Norwegian Caledonides gives a ch
m.y., supporting geological evidence that
tures by reaction of the ultramafic rock with
ing solutions emanating from the country rock
orphism. The initial Sr^{87}/Sr^{86} of the vein
sent day values of the actinolite (0.7077) and
93) within the vein indicate the fluids conta
ambient Sr^{87}/Sr^{86} ratio of the surrounding cr
way of contrast, minerals separated from garne
r within similar ultramafic rocks yield the f

	Rb (ppm)	Sr (ppm)
pside	.008 to .046	23.6 to 112.
tatite	.002 to .005	0.13 to 0.
net	.0012 to .013	0.05 to 1.

Sr^{87}/Sr^{86} values of these minerals are well b
$/Sr^{86}$ ratio of the olivine-chlorite-tremolite
values of some of the diopsides are lower tha