esponse to faulting on the "J"
nts of fault-induced deformation
teral oblique slip, (2) reverse
dip slip and (4) pure right-
essive structural event, new
e orientations. Correlation of
or each structural event suggests
y ore shoots occurred within the
ulting. This study led to the
ly Precambrian in age contrary to
and most previous workers.
ic in the Coeur d'Alene mining
loration and ore discovery.

EAST-CENTRAL IDAHO
logy, Indiana University,
aks, Robert Q., Jr., Department
, Logan, Utah 84322
ician) of east-central Idaho is
dium-bedded, silica-cemented
avy parallel laminae and struc-
rily parallel bedding, omikron-
are locally abundant. Saltation
ppears the principal mode of
redominately southward-flowing
type area suggest a lower energy
f) and may indicate a transition
, turbidity-current-influenced
reserved thickness of 2,285 feet
ic thins southward to 326 feet
than 450 feet in the Clayton
contacts of the Kinnikinic are
w-shelfal, miogeoclinal setting
currents is postulated for de-
thologic uniformity, lateral
leogeographic setting. An anoma-
artz throughout the Kinnikinic
in *situ* straining of quartz grains.

MATION, PICEANCE CREEK BASIN,

Survey, Denver, Colorado 80225
urface rocks to varying degrees.
ires knowledge of the physical
y is the rate of weathering of
he effects of weathering were
ops, sieving of weathered mater-
and freeze-thaw experiments in
Formation tend to be rounded and
iffs of the underlying Green
esistances to weathering and
ase of slopes underlain by Uinta
River rocks and large talus
enty to 50 percent of the talus
.

p32

Freeze-thaw experiments indicated that mechanical weathering of Uinta rocks is rapid; however, rates varied according to rock type. A maximum of 99 weight percent of some sandstone samples was reduced to particles less than 4 mm in diameter after 150 freeze-thaw cycles. Some sandstones were reduced to 92 weight percent less than 4 mm diameter in only 36 cycles. Siltstones were somewhat less affected. Maximum disaggregation for the siltstones was 71 weight percent less than 4 mm in 150 cycles. Results from limestones were variable, ranging from 6 to 54 percent fragment less than 4 mm in 150 cycles. Mudstones and shales were fragmented up to 32 percent less than 4 mm in 150 cycles.

Mechanical weathering may reduce freshly exposed Uinta rocks, especially sandstones, to fragments in as short as 10 years depending upon moisture availability and temperature variation. Most rock types will be significantly affected in 75 years.

DELIMITATION OF SNOW AVALANCHE HAZARD AREAS IN MONTANE COLORADO

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Each year snow avalanches are responsible for loss of life and property in Colorado mountains. It is important to identify areas subject to avalanches, as montane Colorado is experiencing rapid growth. Development is presently encroaching or already in areas of avalanche runout. To answer this need, avalanche studies including examination of ERTS-1 imagery and NASA underflight photography were carried out in the vicinity of Vail, Crested Butte, Telluride and Ophir, Colorado.

Rapid identification of avalanche areas at a regional scale can be achieved by the delimitation of morphological and/or vegetative features on air photos. A bowl-shaped basin on a mountain side which funnels downward into a steep gully above an "alluvial" fan on the valley floor are morphological features indicative of many avalanche systems. Vegetative trimlines on hillsides separating mature from immature forest or meadow, are avalanche-caused features which may accompany the morphological features.

Field identification of avalanche areas for evaluation of land use potential is aided by 1) delimitation of avalanche debris, 2) comparison with nearby morphologically and vegetatively similar avalanche systems and 3) application of Voellmy's (1955) equations designed to calculate avalanche speed and runout distance. Dendrochronology can be used to determine avalanche frequency.

THE WHITE EARTH AREA, MONTANA - A GEOTHERMAL PROSPECT?

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The White Earth area, located along Canyon Ferry Reservoir 30 km east of Helena, Montana, is under investigation for geothermal potential. The thermal gradient in five drill holes (drilled for mineral exploration) ranges from 54 to 223°C/km. The holes cover a distance of abou 3 km, and are between 30 and 75 m deep. The heat flow values range fro about 2μcal/cm^{2}sec (normal for the region) to over 7μcal/cm^{2}sec.

The holes penetrate Oligocene tuffs, bentonites, tuffaceous sandstones, and conglomerates which dip gently east and overlie folded Paleozoic limestone and quartzite. The Paleozoic rocks crop out 150 t 1000 m west of the drill holes. Numerous north-northwest trending faults cut the Tertiary sediments and may reflect a major deep-seated fault, east block down, along the east edge of the Paleozoic outcrop belt. Several east trending faults cut the Paleozoic rocks and may continue beneath the Tertiary beds. The anomalous drill holes lie along the northwest fault swarm near its intersection with the east trending set. Deposits of chert, banded chalcedony, and minor fluorit occur along faults and bedding planes of the Tertiary rocks.

Dissolved silica content of water from the drill holes indicates base temperature of 60-80°C but may be affected by dilution from shallow ground water. The source of the geothermal anomaly may be water heated by circulating to depth along Paleozoic aquifers or faults and rising along the northwest fault system. Reservoir potential may exist in the Paleozoic sequence beneath the Tertiary beds. Thus, the area requires more detailed studies for adequate assessment of the geothermal potential.

A LAMINAR BOUNDARY LAYER MODEL FOR DEPOSITION OF ASH-FLOW TUFFS

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Pyroclastic deposits lacking appreciable sorting and visible stratification are generally interpreted to be the products of turbulent flow. Yet these deposits frequently possess a notable degree of preferred particle orientation (Elston and Smith, 1970) and some exhibit megascopic laminar flow structures (Schmincke and Swanson, 1967). This paradox results from the fact that the mechanics of transportation and deposition are fundamentally different. R. V. Fisher (1966) presented a model for ash-flow emplacement which involved turbulent flowage and simultaneous deposition of particles in a boundary layer. We suggest that flow in the boundary layer is mainly laminar and that the resultan deposits build up layer by layer from the passage of many individual ash flows.

Whether a tuff develops megascopic laminar flow structures depends on whether the temperature of glassy particles entering the boundary layer is above or below the minimum welding temperature. If above, the particles agglutinate, collapse, and weld to form a viscous fluid with a primary flow foliation similar to a lava. If below, the particles fai to cohere and deposition occurs via laminar flow in loose ash. In the latter case, collapse and welding may occur after deposition as increasing load pressure depresses the minimum welding temperature to, or below, the temperature of the glassy particles. Thus, there are both primary and secondary welded tuffs. Air entrained at the rolling front of the turbulent flow, and magmatic gases, may be trapped in the boundary layer during primary welding to form gas pockets ("lenticules", Mackin, 1960) that are often mistaken for pumice cavities.

SEQUENTIAL DEVELOPMENT OF LAMINAR FLOW STRUCTUR
TUFF, CENTRAL COLORADO

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The Wall Mountain Tuff (Oligocene) developed a
laminar flow structures during the transition
rest state in a laminar boundary layer. This
lowing sequence of events are interpreted from
ley where the transport vector is known: 1)aggl
collapse of glassy particles; 2)laminar sheari
welding mass to form a primary flow foliation;
from the collapsing, spongy mass and concentra
shear planes; 4)formation of gas pockets where
pelled exceeded that which could be accommodat
elongation of gas pockets and pumice to form a
of the foliation; 6)formation of gas flotation
which accumulated unusually large volumes of g
primary flow folds with axes perpendicular to
ing of the completely collapsed, densely welde
with formation of tension cracks that dip stee
strike approximately perpendicular to the line
motion. Preservation of delicate primary struc
ary compaction.

More rapid deposition along the sides of
along its axis caused inward accretion of tuff
foliation resulting in a u-shaped channel cros
folds, whose axes parallel the lineation, and
ing occurred locally by creep towards the vall
conformities are visible where less deformed t
primary or secondary folds. All the tuff welc
simple cooling unit.

ORIGIN AND GEOTHERMAL POTENTIAL OF ISLAND PARK

Christiansen, Robert L., U.S. Geological
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Island Park is a topographic basin of compoun
three rhyolitic cycles of the Yellowstone Pla
Bend Ridge, the southwestern rim of Island Pa
the first-cycle caldera, which formed by coll
berry Ridge Tuff eruption 1.9 m.y. ago and wh
ward into Yellowstone National Park. Thurmon
rim of Island Park, bounds part of a second-c
that formed 1.2 m.y. ago as a result of the M
and is nested within the older caldera. This
vated caldera faults on Big Bend Ridge. The
second-cycle calderas are buried by the third
Creek Tuff and younger volcanic rocks. The e
is not a caldera scarp but is formed by large
third cycle. These flows all vented on the M
east.

The youngest major rhyolitic eruptions at Isl
million years ago. Subsequent solidification
bodies that sustained the first two cycles al
of the resulting plutons and eruptions of man