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UNITED STATES GEOLOGICAL SURVEY

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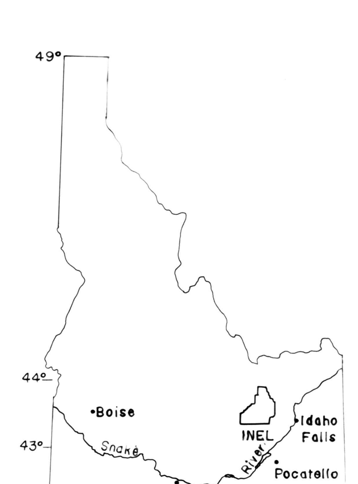
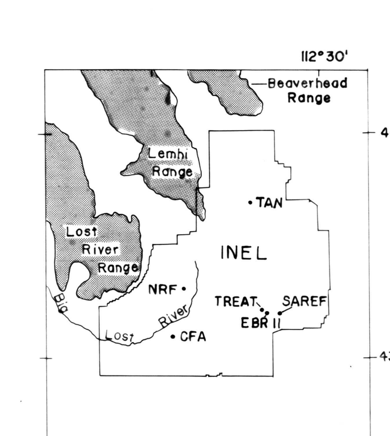
STRATIGRAPHY OF LAVA FLOWS IN DRILL HOLES AT THE PROPOSED SAFETY RESEARCH EXPERIMENT FACILITY (SAREF), ARGONNE NATIONAL LABORATORIES-WEST, NATIONAL ENGINEERING LABORATORY (INEL), IDAHO

By
Mel A. Kuntz
1978



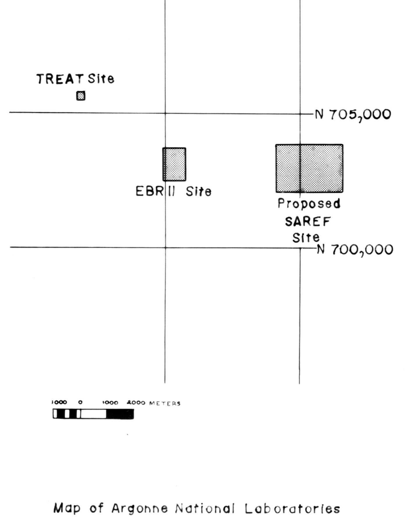
Map of Idaho showing location of INEL



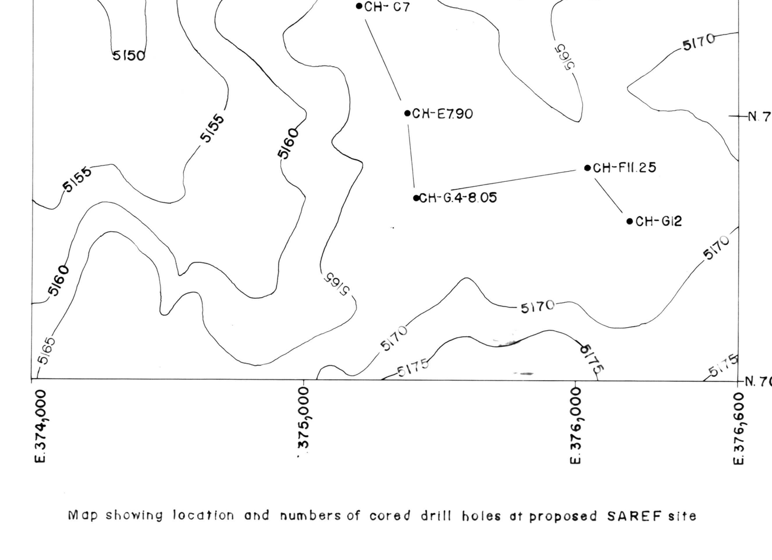
Map of INEL

showing location of various facilities

CFA--Central Facilities Area
EBR-II--Experimental Breeder Reactor II
NRF--Naval Reactor Facility
TAN--Test Area North
TREAT--Transient Reactor Test Facility
SAREF--Safety Research Experiment Facility

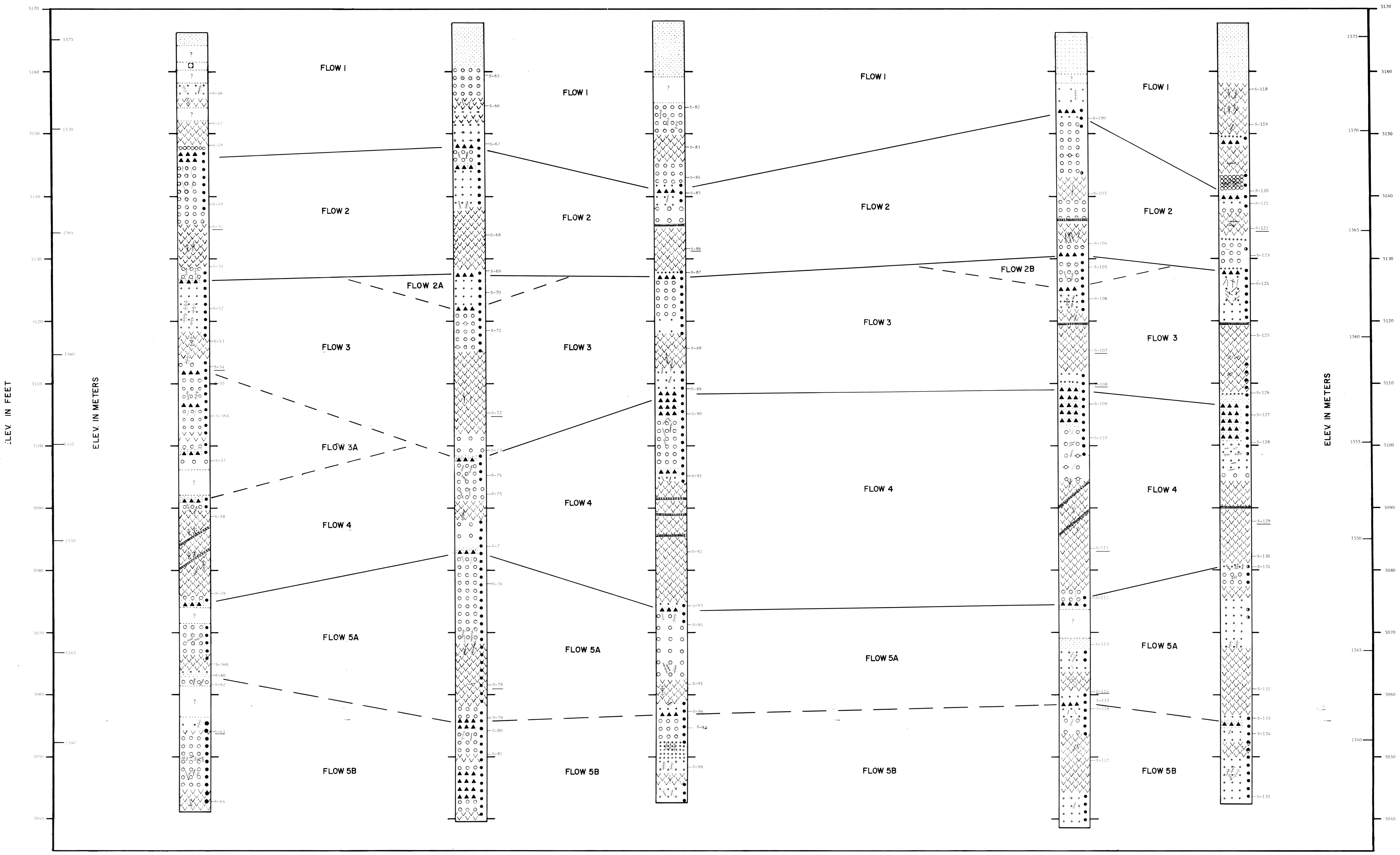


Map of Argonne National Laboratories facilities at INEL (INEL grid system)



Map showing location and numbers of cored drill holes at proposed SAREF site

Elev in feet above sea level



Assisted by: Douglas Hull (1977)
Wendy Fife (1978)

Description of lava flows

Cores from 5 drill holes were studied to determine the basalt lava flow stratigraphy at the proposed Safety Research Experiment Facility (SAREF) Reactor site, Argonne National Laboratories, Idaho National Engineering Laboratory (INEL), Idaho. Five flows were identified and correlated in each of the five holes. Three flow units that could not be correlated were identified in three of the holes.

This diagram displays the textures and structures of the flows and their correlation in the drill holes. Potassium-argon and radiocarbon radiometric age dating studies were carried out on the five flows to determine the recurrence intervals of basalt volcanism which produced flows that covered the SAREF site (Dalrymple, Kuntz, and Kork, 1978, unpub. data). Table 1 summarizes the age determinations. A description of the mineralogy, texture, and structure of each of the flows and flow units follows.

Flow 1: This lava flow was erupted from a vent at Microwave Butte, located approximately 6 km southeast of the SAREF site (Kuntz, Hait, and Scott, 1978, unpub. mapping). About 2 m of eolian silt and sand cover the upper surface of the flow. The thickness of the flow ranges from 1.8 to 5.5 m and averages 4.4 m in the 5 drill holes. The top of the flow consists of vesicular basalt with joints filled by loess. Olivine phenocrysts as much as 1 mm in diameter are set in a matrix of olivine, plagioclase laths, intergranular clinopyroxene, ilmenite, magnetite (all <0.5 mm) and minor amounts of glass. The interior of the flow is massive: olivine crystals about 2 mm in diameter are set in diktytaxitic matrix of plagioclase laths, olivine, intergranular to ophitic clinopyroxene, ilmenite, magnetite (all <0.5 mm) and sparse glass. A vesicular layer 0.1-1 m thick overlies an oxidized scoriaceous base of Flow 1. The vesicular layer contains altered olivine phenocrysts as much as 1 mm in diameter set in a matrix of plagioclase laths, olivine, intergranular clinopyroxene, ilmenite and magnetite, all <0.5 mm.

Flow 2 The thickness of Flow 2 ranges from 4 to 7 m and averages about 5.7 m. A vesicular, oxidized crust as much as 3 m thick caps the flow. The crust contains olivine phenocrysts as much as 2 mm in diameter set in a matrix of plagioclase laths, intergranular clinopyroxene, ilmenite and magnetite (all <1 mm) and sparse glass. Fine-grained iron oxides coat vesicle walls and some olivine phenocrysts are altered to opaque iron oxides. The massive center of the flow, 1.5-3 m thick, is diktytaxitic and consists of slightly altered olivine and ophitic chinopyroxene crystals about 1.5 mm, plagioclase laths about 0.5 mm, and ilmenite and magnetite. Horizontally alined layers of vesicles, about 3 mm thick, are present in the interior of the flow in three of the cores examined. A thin scoriaceous layer less than 0.5 mm thick underlies a thin vesicular base of the massive interior of the flow. The base of the flow is also strongly diktytaxitic and contains olivine phenocrysts as much as 3 mm in diameter. Subophitic clinopyroxene is set in a matrix of plagioclase laths about 0.5 mm long and dispersed opaque minerals.

Flows 2A and 2B: Two flow units, each about 1.75 m thick, are present below Flow 2 in drill holes CH-E7.90 and CH-F11.25. These flows are highly altered with opaque minerals dispersed throughout the matrix and as replacement of olivine crystals. Olivine phenocrysts as much as 2 mm in diameter and subophitic to ophitic clinopyroxene crystals about 1 mm are set in a diktytaxitic, vesicular matrix of plagioclase laths 0.5 mm long and dusty opaque minerals. Similarities in textures and alteration suggest that these two thin flows are local basal flow units of Flow 2.

Flow 3: The thickness of Flow 3 ranges from 3 m to 7 m and averages about 5.5 m. A vesicular oxidized crust 1-3 m thick caps the flow. Joints partly filled with loess are present in the upper parts of this flow in two of the drill cores. The flow is characterized by olivine phenocrysts about 1-2 mm in diameter set in a partly diktytaxitic matrix of olivine, plagioclase laths, intergranular to blade-like ophitic clinopyroxene, ilmenite and magnetite, all <0.5 mm. Olivine phenocrysts typically have rims of opaque minerals and dusty to feathery crystals of opaque minerals are widely dispersed throughout the matrix. The dense interior of the flow averages about 2.5 m in thickness. Olivine phenocrysts, about 2 mm in diameter, are set in a diktytaxitic matrix of olivine crystals and plagioclase laths <0.5 mm, ophitic blades of clinopyroxene 1-1.5 mm long, ilmenite, and magnetite. Alteration of olivine phenocrysts and smaller granules in the matrix varies from strong to weak. The base of the flow is a thin (<0.5 m) scoriaceous layer consisting of porphyritic basalt with olivine phenocrysts as much as 3 mm in a diktytaxitic matrix of olivine, plagioclase laths, intergranular to ophitic clinopyroxene, ilmenite, and magnetite, all <0.5 mm. Alteration of olivine and clinopyroxene crystals is pervasive.

Flow 3A: A 6 m thick flow below Flow 3, consisting of 3 flow units, each with a thin scoriaceous base, is present in drill hole CH-C7. The three thin sections examined from this flow show that it is olivine phyric with phenocrysts as much as 3 mm in diameter. The olivine crystals occur in a dense to diktytaxitic matrix of olivine, plagioclase laths, intergranular to ophitic clinopyroxene, ilmenite, and magnetite, all <1 mm. Altered olivine and clinopyroxene crystals and widely dispersed, fine-grained opaques in the matrix are pervasive in these flows.

Flow 4: Flow 4 is a relatively thick lava flow, ranging from 5 to 10.5 m and averaging about 8 m. The flow is capped by a loess-filled, scoriaceous layer as much as 1.3 m thick. The clinkery cap of this flow is even grained with olivine and plagioclase crystals 1-2 mm set in a diktytaxitic matrix of olivine, plagioclase, intergranular to subophitic clinopyroxene, ilmenite, and magnetite, all about 1 mm. Fine granular opaque minerals are dispersed throughout the matrix; crystals of olivine and clinopyroxene are not altered. The interior of the flow is massive and characterized by horizontal to steeply dipping vesicle layers about 5 mm thick. The interior of the flow is also even grained with olivine crystals, plagioclase laths and anhedral subophitic to ophitic crystals of clinopyroxenes, all about 1-1.5 mm, in a diktytaxitic matrix of the same minerals plus ilmenite and magnetite about 0.5-1 mm. The base of Flow 4 is a thin (0.5 m) layer of vesicular basalt, which is scoriaceous in 4 of the 5 drill cores. Loess fills open spaces between scoria fragments, vesicles, and joint fractures. The texture of the base of the flow is even grained with olivine crystals, plagioclase laths, and intergranular to subophitic clinopyroxene crystals all about 1-1.5 mm set in a finer grained (<1 mm) diktytaxitic matrix of the same minerals plus ilmenite and magnetite. Smaller crystals of olivine in the matrix and altered, widely dispersed fine grained opaque minerals are ubiquitous. The textures and structures of this flow suggest that it may be aa.

Flows 5A and 5B: All 5 drill holes bottomed in a compound lava flow consisting of at least two flow units. The texture of the basalt in the two flow units is unique and identical: the basalt is plagioclase phyric with laths as much as 4 mm long and glomeroporphyritic clots of plagioclase and olivine are found throughout the two flow units. The compound flow exceeds 10 m in thickness. The top of Flow 5A consists of vesicular basalt with joints and vesicles filled with loess. Olivine and plagioclase phenocrysts 1-2 mm long are set in a diktytaxitic matrix of olivine and plagioclase, intergranular clinopyroxene, ilmenite and magnetite, all <1 mm. Fine-grained opaque minerals are widely dispersed through the matrix. The interior of Flow 5A is plagioclase phyric with laths as long as 4 mm set in diktytaxitic matrix of olivine, plagioclase, intergranular clinopyroxene, ilmenite, and magnetite, all <1 mm. Other distinctive textural features are glomeroporphyritic clots of plagioclase and olivine, small amounts of glass, and chlorophaeite in the matrix. Hand specimens display pervasive iron oxide alteration but the rock is not significantly altered in thin section. The base of Flow 5A is characterized by a scoria layer <0.5 m thick. Plagioclase laths as long as 4 mm are set in a diktytaxitic matrix of olivine, plagioclase, intergranular clinopyroxene, ilmenite, and magnetite, all <1 mm. Glomeroporphyritic clots of plagioclase and olivine, minor amounts of glass in the matrix, and widely dispersed fine-grained opaque minerals are characteristic features.

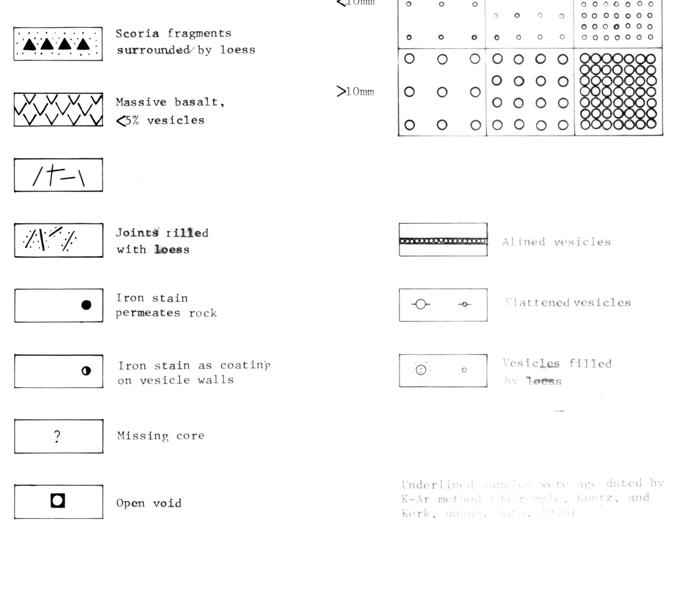
The top of Flow 5B consists of variable amounts of vesicular and massive basalt, all fairly strongly altered. Joint surfaces and vesicles are filled by loess. The basalt of this unit is typically plagioclase phyric with laths as long as 4 mm set in a partly diktytaxitic matrix of plagioclase, olivine, intergranular clinopyroxene, ilmenite and magnetite. Glomeroporphyritic clots of plagioclase and olivine are charcteristic. Olivine crystals are strongly altered to opaque minerals and the fine-grained matrix is charged with widely dispersed, fine-grained opaque minerals. All 5 drill holes bottom in vesicular to massive basalt having mineralogical and textural characteristics which are identical to those described for the top of Flow 5B.

Table 1.--Estimated ages of lava flows in cored drill holes at the proposed SAREF site

Flow	Age	Method	Source
1	14,320±350 yrs.*	^{14}C	Meyer Rubin, written commun., 1978
2	135±38 x 10^3 yrs.	K-Ar	G. Brent Dalrymple, written commun., 1978
3	143±21 x 10^3 yrs	K-Ar	G. Brent Dalrymple, written commun., 1978
4	210±24 x 10^3 yrs	K-Ar	G. Brent Dalrymple, written commun., 1978
5A	352±20 x 10^3 yrs	K-Ar	G. Brent Dalrymple, written commun., 1978
5B	331±20 x 10^3 yrs	K-Ar	G. Brent Dalrymple, written commun., 1978

* The author believes that this date is too young due to contamination of the sample by modern organic material.

EXPLANATION OF SYMBOLS



Underlined samples were age dated by K-Ar method (Dalrymple, Kuntz, and Kork, unpub. data, 1978)