LITHOLOGIC DESCRIPTION OF THE "SITE E COREHOLE", IDAHO NATIONAL ENGINEERING LABORATORY, BUTTE COUNTY, IDAHO

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U.S. Geological Survey Open-File Report 90-487

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INTRODUCTION

The "site-E corehole" (T. 3 N., R. 30 E., common corner of sec. 15, 16, 21, and 22) was drilled at the Idaho National Engineering Laboratory, Butte County, Idaho in spring, 1984. Its purpose was to provide subsurface geologic information as part of an environmental impact study for potential siting of the New Power Reactor. Participants in the project included the Department of Energy; E.G.&G., Idaho, Inc.; and the U.S. Geological Survey.

The Idaho National Engineering Laboratory is located in the northwest section of the eastern Snake River Plain (Fig. 1), a region dominated by late Cenozoic and Quaternary basalt volcanism (Kuntz and others, 1982). Most basaltic units are Pleistocene and Holocene in age and were emplaced as low shield volcanoes, fissure flows, or tube-fed pahoehoe flows (Greeley, 1982).

Site-E drilling penetrated eleven olivine tholeiite basalt flows. The hole is 185.6-m-deep corehole. Of these eleven flows, four are simple flows and seven are compound flows (cf., Walker, 1972). Intercalated with these flows are at least four sedimentary interbeds that have generally poor core recovery. There may be several more similar sedimentary interbeds although these are indicated by core that was not recovered. Greater than 85% total recovery of core was obtained from the 2.1-185.6 m interval. Figure 2 is a schematic sketch of the lithologic units present in the site-E corehole.

LITHOLOGIC DESCRIPTIONS

Flow 1: (interval, 2.1-9.3 m; thickness, 6.9 m). Core was not recovered until 2.1 m. Flow 1 is a simple flow unit; the top 1 m of the flow unit is 1 m of medium dark grey vesicular basalt. The massive interior of the flow is slightly more phyric than the top and is diktytaxitic; locally pipe vesicles are present. Plagioclase (< 2 mm in length) and olivine (<1 mm in diameter) phenocrysts are set in a groundmass of plagioclase, olivine, subophitic augite, magnetite and ilmenite, and subordinate interstitial glass; olivine phenocrysts show a slight alteration to iddingsite along surfaces and fractures. Locally the unit is glomeroporphyritic. The base of the flow shows a slight decrease in phenocryst content and an increase in glass and abundance of vesicles. Oval to elongate vesicles range in size from 0.5-3.0 cm, comprise 20-30 percent of the total rock volume, and have oxidized linings. The vesicular basal layer overlies an oxidized, scoriaceous base. This unit has a K-Ar age of 233 ka$\pm$34 (Fig. 2) (Champion et al., 1988.)

Flow 2: (interval, 9.3-18.1 m; thickness, 5.8 m). Flow 2 is a compound flow and consists of three flow units (designated as flow units 2a, 2b, and 2c), the bases of which occur at 14.0 m, 15.4 m, and 18.1 m, respectively. Each flow unit has an oxidized, vesicular, clinkery surface and a base which consists of a thin (0.1 m) layer of vesicles overlying a thin (<0.1 m) oxidized scoria. Flow unit 2a is relatively thick (4.7 m) compared to other flow units in flow 2, has a prevalent purplish coloration, and is predominantly vesicular; with increasing depth, vesicles decrease in abundance and increase in size to as much as 2 cm in diameter at approximately 12.5 m. Below this depth, the interior of the unit is massive. Plagioclase laths and subhedral olivine phenocrysts are set in a groundmass of plagioclase, olivine, magnetite, ilmenite, augite, and

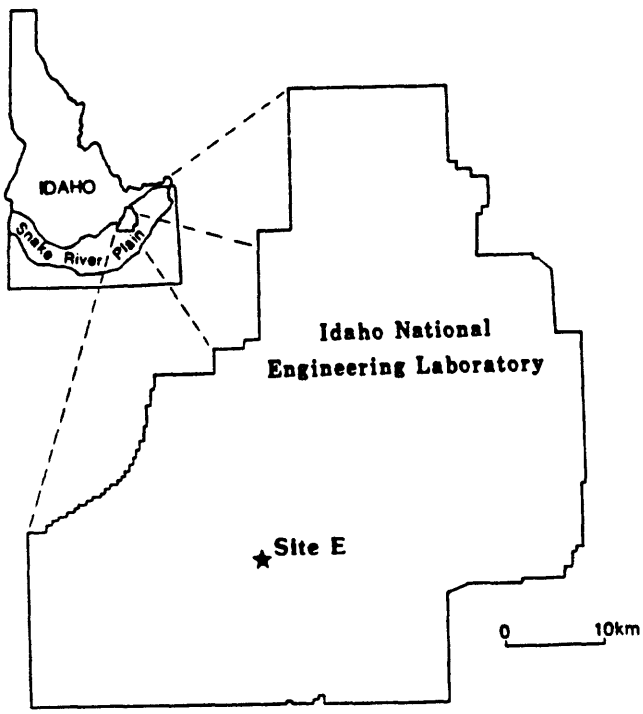

Fig. 1. Location map of the Idaho National Engineering Laboratory and the Site-E corehole on the eastern Snake River Plain (modified from Champion et al., 1988).

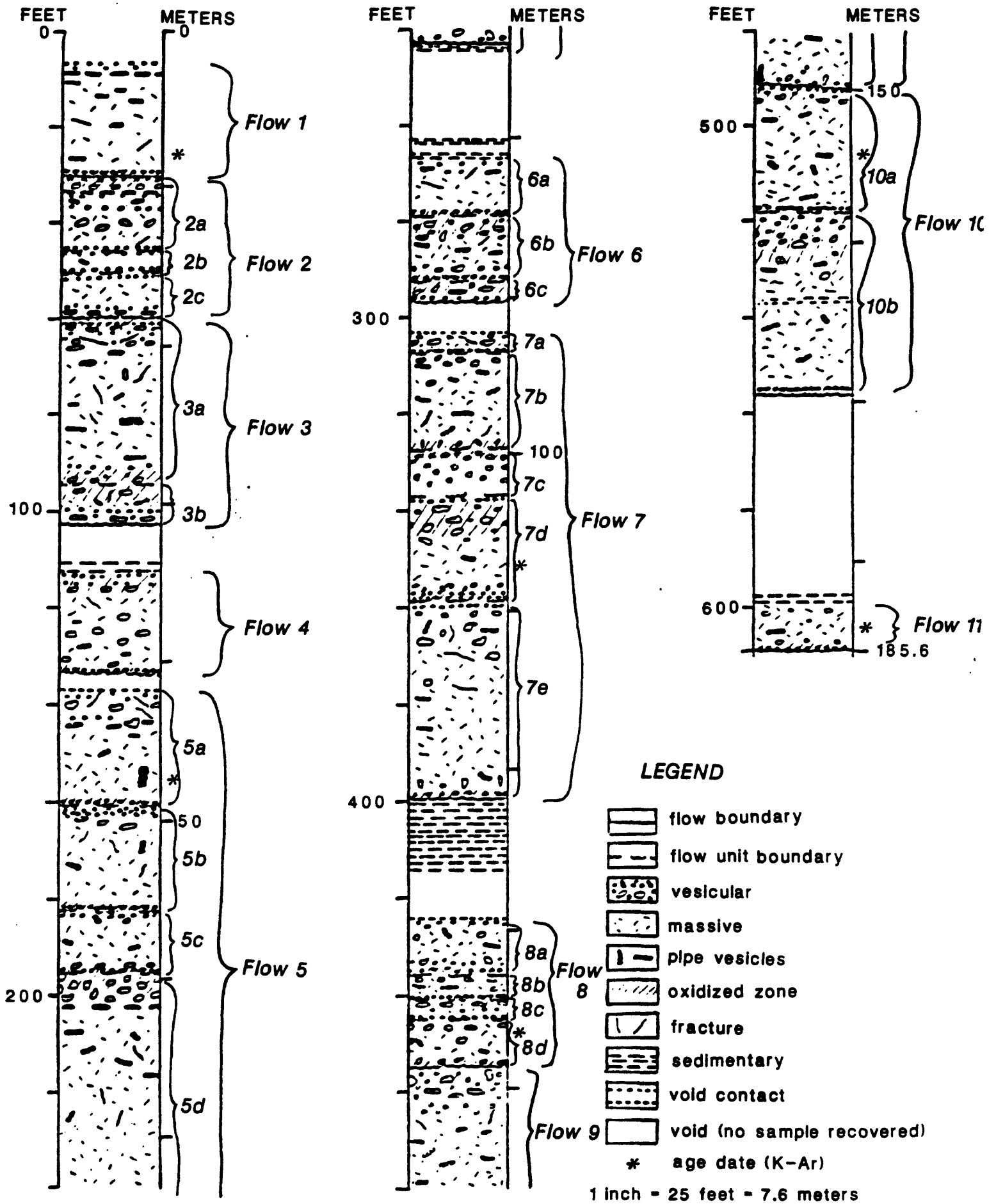

Fig. 2. Log of the core stratigraphy.

subordinate interstitial glass; locally the unit is glomeroporphyritic. Olivine phenocrysts show slight alteration to iddingsite along surfaces and fractures. Flow units 2b and 2c similar to 2a and are medium dark gray, massive, diktytaxitic, and locally contain pipe vesicles.

Flow 3: (interval, 18.1-31.2 m; thickness, 13.1 m). Flow 3 is a compound flow consisting of two flow units, each with an oxidized top and a base which has a thin vesicular layer overlying an oxidized scoria. Flow unit 3a is 10.7 m thick and overlies flow unit 3b which is 2.4 m thick. The top of flow unit 3a is vesiculated and slightly oxidized; many of the fractures and vesicles present are filled with caliche. The interior of this unit is medium dark grey, massive, and diktytaxitic; pipe vesicles are locally present. The unit is glomeroporphyritic with plagioclase and olivine phenocrysts are set in a groundmass of plagioclase, olivine, magnetite, ilmenite, augite, and subordinate interstitial glass. Many of the olivine phenocrysts are anhedral and have a coating of finely disseminated opaque oxides. Flow unit 3b is distinguished petrographically from flow unit 3a in that the former unit has more olivine present as phenocrysts.

Interval 31.2-34.3 m: no sample was recovered between 31.2-34.0 m. A sedimentary unit is present from 34.0-34.3 m; the interbed consists of an orangish-tan, well-sorted, fine-grained sand. This sediment contains angular basaltic fragments (< 1 mm diameter).

Flow 4: (interval, 34.3-40.7 m; thickness, 6.4 m). Flow 4 is a simple flow unit. The top of the unit is oxidized, clinkery, and vesicular; sediment and caliche from the overlying sedimentary interbed coats the rubbly surfaces and fractures. At 35.5 m, a slight purplish alteration is present. The top of flow 4 is vesicular from 34.3-35.8 m; vesicle size ranges from 0.5-2.5 cm. The interior of the flow is dark grey, massive, and diktytaxitic; from 37.8-39.0 m a zone of vesiculation is present. Phenocrysts of olivine and plagioclase are set in a groundmass of plagioclase, olivine, subophitic augite, opaque oxides, and subordinate interstitial glass; the unit is glomeroporphyritic. Pipe vesicles are present locally. A thin (<0.1 m) zone of vesicles overlies a slightly oxidized scoriaceous base; void spaces are filled with light tan caliche-bearing loess.

Flow 5: (interval, 41.5-74.1 m; thickness, 32.6 m). Flow 5 is a compound flow and consists of four flow units (designated as flow units 5a, 5b, 5c, and 5d); flow unit bases are located at 49.1 m, 55.6 m, 59.6 m,and 74.1 m, respectively. Each unit has a vesicular capping layer and a thin (<0.3 m) vesicular layer overlying an oxidized scoriaceous base. Interiors of the individual flow units are medium dark grey, massive, diktytaxitic, and contain local pipe vesicles and fractures. The basalt consists of plagioclase laths, anhedral to subhedral olivine, subophitic augite, magnetite, ilmenite, and interstitial glass; locally the flow is glomeroporphyritic. Flow unit 5a has a thick vesicular top; many of the vesicles and fractures present in this zone are filled with caliche. Several of the fractures present in the individual flow units are coated with loess; the presence of loess on fracture surfaces may be attributed to a break in time between emplacement of subsequent flow units or, more likely, due to infiltration of loess along fractures. This unit has a K-Ar age of 350 ka$\pm$40 (Fig. 2) (Champion et al., 1988).

Interval 74.1-81.3 m: At 74.1-74.2 m, a sedimentary interbed consisting of reddish-orange, well-sorted, fine grained silt is present. No sample was recovered from 74.2-80.1 m. Ten centimeters of tan clay was recovered at 80.1 m. No sample was recovered from 80.2-81.0 m. From 81.0-81.3 m, tan clay was recovered.

Flow 6: (interval, 81.3-90.5 m; thickness, 9.2 m). Flow 6 is a compound flow and consists of three flow units (designated as flow units 6a, 6b, and 6c), whose bases are located at 85.0 m, 89.3 m, and 90.5 m respectively. Each flow unit has a vesiculated capping layer; the top of flow unit 6a contains caliche-coated fractures and vesicles. The tops of flow units 6b and 6c are thermally oxidized. The interior of each flow unit is massive, diktytaxitic, and locally contains pipe vesicles. The medium to dark grey, phyric basalt contains plagioclase laths, subhedral to anhedral olivine, subophitic augite, magnetite, ilmenite, and interstitial glass. Phenocrysts of plagioclase (as large as 2-3 mm in length) are present; olivine phenocrysts (as large as 1 mm in length have surfaces which have been altered to iddingsite. The bases of flow units 6a and 6b have a thin layer of abundant, tiny (< 5mm) vesicles which have oxidized linings.

Interval 90.5-92.4 m: no sample recovered.

Flow 7: (interval, 92.4-121.8 m; thickness, 29.4 m). Flow 7 is a compound flow and consists of five flow units (designated as flow units 7a, 7b, 7c, 7d, and 7e); bases are at 93.7 m, 99.0 m, 103.3 m, 109.4 m, and 121.8 m, respectively. Each flow unit is petrographically similar. The top of each flow unit is recognized by a vesicular capping layer; the top of flow unit 7a has fractures and vesicles which are coated with caliche. Vesicles in the capping layers of flow units 7b, 7c, and 7d have oxidized linings; thermal oxidation in the top of flow unit 7d is extensive and is approximately 2.4 m thick. The interiors of the thicker flow units (7b, 7c, 7d, and 7e) are massive, locally diktytaxitic, and locally contain pipe vesicles. Some of the fractures present in the massive interiors are coated with loess probably due to infiltration. Phenocrysts of plagioclase (<2 mm in length) and olivine (<1 mm in diameter) are set in a groundmass of plagioclase, olivine, subophitic augite, magnetite, ilmenite, and interstitial glass. Locally the units are glomeroporphyritic; clusters of olivine and plagioclase are as large as 8 mm in diameter. Many of the olivine phenocrysts are surficially altered to iddingsite. The base of each flow unit is recognized by a thin layer of abundant, tiny (<5 mm) vesicles; in flow units 7d and 7e, the thin vesiculated layers overlie oxidized scoriaceous bases. This unit has a K-Ar age of 441 ka$\pm$77 (fig. 2) (Champion et al., 1988).

Interval 121.8-129.2 m: Orangish-red, well-sorted, fine-grained silt; this unit contains approximately 2% black angular basaltic fragments. The lower 0.1 m of this interval consists of a tan clay. No sample was recovered from 126.2-129.2 m.

Flow 8: (interval, 129.2-138.7 m; thickness, 9.4 m). Flow 8 is a compound flow and consists of four flow units (designated as flow units 8a, 8b, 8c, and 8d); bases of the flow units are at 132.9 m, 134.4 m, 135.6 m, and 138.7 m, respectively. Tops of individual flow units are recognized by a vesicular capping surface; vesicles and fractures in the top of flow unit

8a contain caliche and loess from the overlying sedimentary interbed. Vesicles in the tops of flow unit 8b, 8c, and 8d have oxidized linings. The interior of each flow unit is massive, locally diktytaxitic, and contains local pipe vesicles. Phenocrysts of plagioclase and olivine are more abundant and larger in interiors of the flow units than in the tops and bases. These phenocrysts are set in a groundmass of plagioclase, olivine, subophitic augite, magnetite, ilmenite, and subordinate interstitial glass; locally flow 8 is glomeroporphyritic. Some olivine has been altered to iddingsite. The base of each individual flow unit is recognized by a thin layer of abundant, tiny vesicles capping an oxidized scoriaceous bottom; the vesicles are lined with oxidized opaque oxides. This unit has a K-Ar age of 491 ka±80 (fig. 2) (Champion et al., 1988).

Flow 9: (interval, 138.7-149.7 m; thickness, 11.0 m). Flow 9 is a simple flow. The top of this unit has an oxidized clinkery surface and abundant vesicles ranging in size from 0.5-3.5 cm; in the upper 0.7 m, many of the vesicles and several fractures have an oxidized lining and are coated with caliche. The basalt is vesicular to a depth of 143.0 m. The interior of the flow is massive, locally diktytaxitic, and has local concentrations of pipe vesicles. This dark gray unit is essentially aphyric and consists of a groundmass of plagioclase laths, anhedral and subhedral olivine, subophitic augite, magnetite, ilmenite, and subordinate interstitial glass. The base of flow 9 is marked by a thin layer of sparsely distributed (<3 %) vesicles ranging in size from 0.5-5 cm overlying an oxidized scoriaceous base.

Flow 10: (interval, 149.7-169.5 m; thickness, 19.8 m). Flow 10 is a compound flow and consists of two major flow units (designated as flow units 10 a and 10b); bases of the flow units are at 158.0 m and 169.5 m, respectively. The top of flow unit 10a is recognized by an oxidized layer containing abundant vesicules; many of the vesicles are coated with caliche. Flow unit 10a is medium dark gray, porphyritic, massive, diktytaxitic, and locally contains concentrations of pipe vesicles. Plagioclase (2-3 mm in length) and olivine (1 mm in diameter) phenocrysts are set in a groundmass of plagioclase, olivine, subophitic augite, magnetite, ilmenite, and subordinate interstitial glass; many of the surfaces of the olivine phenocrysts are irridescent and show a slight alteration to iddingsite. The base of flow unit 10a is recognized by a thin (0.15 m) layer of tiny (0.2-1.0 cm) vesicles. The top of flow unit 10b is recognized by a relatively thick (approximately 3 m) layer of vesicular basalt which shows a prevalent purplish coloration due to thermal oxidation. Vesicles decrease in abundance with depth. The interior of flow unit 10b is medium dark gray, massive, and contains local concentrations of pipe vesicles. Some fractures present are covered with loess probably deposited by later infiltration. Petrographically, flow unit 10b is similar to flow unit 10a. A clay lens (5 cm thick) occurs at 163.8 m; this lens may be a misplaced core fragment as no lithologic change occurs above or below the lens and the lens occurs in the middle of the flow unit interior. The base of flow unit 10b has a thin (0.2 m) layer of tiny vesicles (<1 cm) overlying an oxidized scoriaceous base; cracks in the base contain soil. This unit has a K-Ar age of 580 ka ±93 (fig. 2) (Champion et al., 1988).

Interval 169.5–182.6 m: most of the material in this interval was not recovered although two thin (< 15 cm) sedimentary interbeds are present. The upper interbed occurs at an unknown depth in this interval. The unit is medium brown, moderately to well-sorted, fine-grained, unconsolidated sand composed of quartz, feldspar, red cinder, and basalt; the sand contains <5% of gray, rounded to subrounded, quartzite clasts up to 5 mm in diameter. The lower sedimentary interbed is similar to the upper interbed but is not as well sorted, is more indurated, and contains approximately 10% subrounded clasts of quartzite and basalt up to 5 mm in diameter.

Flow 11: (interval, 182.6-185.6 m; thickness, 3.0 m). Flow 11 is a simple flow. The top of the unit is slightly vesicular (<2% of the total rock volume). The interior of the flow is medium dark gray, massive, diktytaxitic, and locally contains pipe vesicles. Plagioclase and olivine phenocrysts (<2 mm) are set in a groundmass of plagioclase, olivine, subophitic augite, magnetite, ilmenite, and interstitial glass; some of the olivine phenocrysts show alteration as indicated by irridescent surfaces and iddingsite present on fractures of the olivine phenocrysts. The base of flow 11 is recognized by a thin layer of tiny vesicles overlying a slightly oxidized scoriaceous rubble. This unit has a K-Ar age of 641 ka±54 (fig. 2) (Champion et al., 1988).

SUMMARY

The site E corehole, described herein, consists of eleven basalt flow units, several of whose flow boundaries are marked be sedimentary interbeds. A detailed study using K-Ar ages and paleomagnetic data compliments this description and indicates that the flows are older than 233 ka±34 and younger than 641 ka±54 (Champion et al., 1988).

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