

Lithologic Log Addendum

Well ST-4-690

Cuttings of the lithologic unit from well ST-4-690 were sent to the Department of Geological Sciences, New Mexico State University (NMSU), Las Cruces, New Mexico, for detailed petrographic analysis when identification of fine-grained, highly altered volcanic rocks at the NASA-WSTF site became difficult using conventional field methods. Petrographic reports from NMSU were received after the printing of these lithologic logs, hence the need for this addendum. The petrographic description from NMSU is included below.

Previous unit name based on field identification: **Tuff**

New Unit name based on petrographic analysis: **Tuff with Andesite**

ST-4-690 (665' - 670')

Ash-flow tuff

Origin: ash-fall or ash-flow tuff
Texture: fragmental, non-welded, weakly porphyritic
Phenocryst mineralogy: plagioclase + sanidine + augite + biotite
Porosity: up to 20% within grains, also along veins
Alteration: clay throughout, calcite in veins

This sample has a very fine-grained, fragmental, moderately-welded ashy matrix that surrounds vesicular pumice fragments and approximately 5% phenocrysts. Plagioclase (2%, 0.1 mm), sanidine (2%, 0.1 mm), augite (0.5%, 0.08 mm), and biotite (0.5%, 0.08 mm) constitute the phenocryst assemblage. Porosity is very low within the grains, but possibly much higher along veins. Alteration is moderate. Clay is present throughout the rock, and calcite is found in veins. The sample probably originated as an ash-flow tuff.

ST-4-690 (705' - 710')

Volcanic rocks: welded crystal ash-flow tuff and biotite-augite andesite

This sample contains two main lithologies: welded ash-flow tuff and andesite. Together, they indicate a volcanic terrain.

Ash-flow tuff

Origin: ash-flow tuff
Texture: welded pyroclastic, porphyritic
Phenocryst mineralogy: plagioclase + sanidine + quartz + augite + biotite + orthopyroxene

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Well ST-4-690 (cont'd)

Porosity: low
Alteration: very low

The lighter-colored fragments in this sample are welded ash-flow tuff. Glassy pumice fragments and ash shards are moderately welded. Approximately 10% crystals are present, commonly broken. Plagioclase (0.2 - 1.0 mm) phenocrysts are resorbed. Euhedral sanidine (0.5 - 1.4 mm) and anhedral quartz (0.5 mm) phenocrysts are broken. Both orthopyroxene (0.1 - 0.3 mm) and augite (to 0.7 mm) are present with yellow to red-brown pleochroic biotite (to 0.6 mm). This sample originated as a welded ash-flow tuff. One fragment in the thin section is a hematite-cemented quartz arenite with recycled subrounded quartz grains. This could represent either an intercalated sandstone bed or, more likely, a lithic fragment in the ash-flow tuff.

Porphyritic biotite-augite andesite

Origin: lava flow
Texture: glassy porphyritic
Phenocryst
mineralogy: plagioclase + augite + biotite
Porosity: very low
Alteration: very low

This glassy lava contains 12% phenocrysts in a groundmass of glass with microlites of plagioclase, oxides and pyroxene. Plagioclase phenocrysts (6%, 0.15 - 3.0 mm) are resorbed. Euhedral augite phenocrysts (0.1 - 0.7 mm) constitute 4% of the rock. Biotite (0.7 mm, gold to red-brown pleochroism) and microphenocrysts of FeTi oxides each form 1% of the rock. These fragments were originally part of an andesitic lava flow.

ST-4-690 (760' - 763')

Porphyritic augite andesite

Origin: lava flow
Texture: aphanitic porphyritic
Phenocryst
mineralogy: plagioclase + augite + sanidine + FeTi oxides
Porosity: low except along alteration veins
Alteration: low to moderate, calcite and clay replacement of phenocrysts, calcite veins

Approximately 15% phenocrysts are present in a fine-grained matrix of plagioclase, augite, oxides, and devitrified glass. Plagioclase phenocrysts (9%, 0.07 - 1.7 mm) are subhedral to euhedral and somewhat resorbed. Augite phenocrysts (0.005 - 1.2 mm) are subhedral to

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Well ST-4-690 (cont'd)

ehedral. Sanidine (0.5%, 0.5 mm) occurs as broken crystals. Subhedral FeTi oxides (0.05 - 0.15 mm) are present as microphenocrysts. A trace of apatite is present in augite and plagioclase phenocrysts. Porosity is generally low, except along veins. Alteration is not extensive, consisting largely of clay and hematite replacement of pyroxene and oxides, respectively. Plagioclase is still fresh. Calcite is present in veins. The sample originated as a lava flow.