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Dear Ms. Mann,

Below are my interpretations of drilling results thus far on well AK-3, the third thermal gradient well in the Hot Springs Bay Valley (HSBV) field on Akutan Island, Alaska.

Summary of drilling progress thus far:

Drilling to date has progressed from the surface to 176.5' over four days of active drilling. The well very shallow (flowed 190 °F fluid when pulling pipe from 159', presumably from fractured / mineralized zone between 140-143' depth. The well kicked again when at 176.5' with ~176 °F fluid, but the depth of heating was not known/reported (may have been 140-143' again, or near the bottom of the well, ~169').

Lithology notes

Overall, the lithologies encountered are very similar to those observed in TG-2 (340 yards NE of AK-3). There is significantly higher recovery from the shallow portions of this well compared to TG-2. Dominantly andesite and basalt lava flows, with intermittent mass wasting deposits (called "lithic basalt" in core logs). Shallow recovery of scoria at 5' and 7-8' is the first occurrence of scoria in any HSBV core. Clay-rich sections in the top 20' are likely glacial and from modern swampy conditions at the surface (although clay composition cannot be determined). Strong alteration (argillic?) occurs at 168-170'. This was not observed in TG-2

Alteration notes

As in the TG-2 core, surficial valley-filling deposits (lahars, clays, till, etc.) dominate the upper 50' of the core. Below this, generally weak to very weak alteration is present from 64' - ~125', with slightly increased alteration at ~105'. Moderate to strong alteration at 168-170', with white to blonde colored alteration (argillic?). This may correspond to a zone of high permeability based on well kick just below this depth. Minor epidote observed at 78'.

Permeability notes

Network of fractures at 109' with altered margins. Fractured zone at 118'; another at 123' with what appears to be chlorite alteration below it. Fractured zone at 135' with alteration zone above it (125-129'). Another fracture zone occurs 140-143, with fractures partially filled with vuggy quartz (?) and generally weakly altered. This zone is potentially associated with high permeability flow zone of 190 °F water. Another high permeability zone occurs at 169-171 ft, with strongly altered rock surrounding a mineralized zone of quartz, calcite

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Comparison to TG-2

Well TG-2 apparently cooler fluids that flowed at shallower depth than AK-3. In TG-2, a 122 °F "artisian flow" was described as they pulled out of the hole at 33'. The shallowest flow at AK-3 is much hotter (~70 °F hotter) and deeper (by ~105') than that encountered in TG-2, and apparently much stronger flow (enough to push 80 feet of pipe out of the hole). If these features are connected, the orientation of that permeable network would have an apparent dipping of ~4.5° up-valley toward AK-3. This is about 20° off from the orientation of lava flows exposed in the valley walls above AK-3, which dip down-valley at ~15°.

Similarly, a fracture network in TG-2 at 157' filled with quartz, calcite and pyrite and minor clay-rich alteration occurs at the lithologic contact between lower andesite and overlying basalt at an orientation of ~15°. In AK-3, a fracture network partially filled with quartz, calcite and pyrite at an orientation of ~10° with strong alteration surrounding the network occurs at 168-171'. If these are connected between the two well sites, the broader orientation would be effectively horizontal (0.7°). These fractures could also be offset by the fault system we are targeting with this well site. If this is accurate, it would indicate ~150-250' of offset on the fault (very rough).

I agree with your interpretations, Mary, that the overall low degree of alteration in the lava flows occurring between 50-168', suggests that the low permeability lava flows in the uppermost portion of the well are acting as a fairly effective cap on the system.

Moving forward

Well TG-2 does not have substantial alteration or mineralization shallower than ~205' depth. The alteration observed in AK-3 is much more substantial and shallower than in TG-2. Keep an eye on fracture density in AK-3. If the fault structure implied to exist occurs at an angle of ~60° as hypothesized, this fluid-path-controlling fault should be encountered at ~400' depth (+/- 100 ft based on the very simplistic assumptions). This could be the major control of shallow fluid flow path. The minor fluid flow shallower than this depth is likely to be inconsequential to geothermal development.