Stelco Magma Consulting

Addendum to AK-3 Advising Report #1

Comparison to TG-2

The siting of AK-3 was based in large part on a normal fault interpreted to exist between TG-2 and AK-3 dipping SW (up-valley) at ~60°. If this is accurate, the lithologic contacts in AK-3 should generally be deeper than those in TG-2. This is complicated by two factors: the valley fill in AK-3 is ~10 m thinner than in TG-2; and that a different wellside geologist is logging the core at AK-3, leading to substantial uncertainty in lithologic descriptions (particularly the highly subjective distinction between "basalt," "andesite," and "lithic basalt"). In TG-2, the shallowest occurrence of lithic basalt is at 292', whereas in AK-3 it is at 126'. If these units are related (which is unlikely), the offset on the fault is ~150' and the sense of motion is reverse. Presumably, the presence of tuff in the AK-3 well will provide more reliable positioning in the stratigraphic sequence. Tuff in TG-2 is very fine grained (usually containing abundant glass and plagioclase with minor cpx), prone to fracturing at regular orientations (0, 30, 60, 90° from horizontal) and typically light blue/green/gray in color due to alteration. In TG-2 the shallowest occurrences of tuff are at 390' and 400' depth, but it is possible (likely) that these are clasts within a very thick debris flow (lithic basalt) unit. The shallowest in-place tuff unit in TG-2 appears to be at ~412-416' and has significant fracturing, vug- and vein-filling mineralization and abundant epidote in vugs. The unit lies on top of an andesite flow and is overlain by "lithic basalt" or mass wasting deposit of variable clast size.

A fracture network in AK-3 at 168-171' depth occurs at or near the contact between overlying lithic basalt and underlying andesite and contains cracks partially filled with quartz, calcite and pyrite at an orientation of ~10° from horizontal with strong alteration surrounding the network. This matches a fracture network in TG-2 at 157' at the lithologic contact between overlying basalt and underlying andesite that is filled with quartz, calcite and pyrite and minor clay-rich alteration at an orientation of ~15° from horizontal. If these are connected between the two well sites, the broader orientation would be effectively horizontal (~0.7°, assuming 1000' between wells and that the fracture network is not offset by the fault). If the fracture angles of 10-15° reported in both TG-2 and AK-3 are continuous across the hypothesized fault, the fault would need to have ~30' of normal displacement (downdropped to the SW). The latter is consistent with expectations of the fault based on structural mapping. If the fluid flow is continuous through these fractures, the normal fault would be acting as a high-permeability fluid pathway rather than an aquitard.

Moving forward

If the fault mapped between wells TG-2 and AK-3 has an angle of ~60° as hypothesized, this structure could be encountered at ~430' depth, +/ ~250'. This high degree of uncertainty stems from assumptions that 1) the fault trace is equidistant (500') between wells TG-2 and AK-3, and 2) that the fault dips at a 60°. The location of the surface fault trace may vary as much as +/- ~250 m. Fault orientation uncertainty is +/- 15°.

A second fault has been mapped at the surface parallel to and ~1,000' downvalley of the fault discussed above. Assuming this fault continues to be parallel at depth, well AK-3 would intersect this fault ~850' deeper than the first. This may be below the planned T.D. of the hole.

Observations of slickenlines in the core and the indications of motion direction will be important for characterizing these fractures. Also, diagnostic lithologic changes will be important for determining offset on the fault.