Overview of American Metals Exploration Corp. Lithium Projects

By M.C. Newton, March 10, 2024

American Metals Exploration Corp. has determined that the Great Basin is a giant closed pull-apart basin which evolved tectonically by the amalgamation of smaller pull-apart basins that decreased in age from NE to SW, coincident with the documented SW migration of the magmatic front, interpreted to be due to roll-back of the subducted Farallon plate from Eocene through Miocene time.

Larger pull-apart basins were characterized by central ridge systems called the hinge zones, with parallel basins and ranges forming on either side by transtension as the basins grew (see Figure 1). The hinge zone, while basically staying in the same position, itself sometimes rifted and, commonly small closed volcanotectonic rift basins formed within the hinge zone complex. These small basins may also have been pull-apart basins and most commonly formed concomitantly with explosive felsic ignimbritic eruptions which formed calderas, usually in one end of the basin. The parts of the basins outside the calderas were likely the result of subsidence into the magma chamber from which the ignimbrite eruptions emanated.

The calderas that have been identified by Great Basin that are known to be associated with lithium/boron deposits commonly formed near the ends of hinge zones. This is true of the Miocene McDermitt caldera which hosts the Thacker Pass lithium clay deposit (touted as the largest lithium resource in the world) at the northern end of the Lahontan Basin hinge zone (see Figure 2). Likewise, the lithium brine deposit of Albemarle Corporation (the only operating lithium brine mine in North America) and the other two lithium clay/salt deposits currently under development in Nevada, Ioneer’s Rhyolite Ridge deposit and Century Lithium’s Clayton Valley deposit, all occur in the southern end of the Oligocene-Miocene Round Mtn. Basin hinge zone (see Figure 2).

This is not by chance. Lithium is an element that is very incompatible in most rock-forming minerals, and it is highly enriched in the residual fluids at the top of a crystallizing felsic magma body prior to volcanic eruption. Like in a pressure cooker, in which as long as the pressure is high, liquid remains liquid even as temperature rises above the typical boiling point, the longer pressure is maintained over a magma chamber, the longer the magma can remain liquid, forming crystals withdrawing rock-forming elements and enriching the residual liquid in incompatible elements like lithium. The process ends when the lid is cracked open, the pressure suddenly drops, liquid flashes to gas and a violent eruption ensues.

As can be seen in Figure 1, the central part of a hinge zone (in red) is dilational, but the ends of a hinge zone (in blue) are actually zones of shortening, due to the internal blocks of the pull-apart basin, on either side of the end of the hinge zone, moving toward each other. The resulting compression across the end of the hinge zone keeps the lid on and allows magma to remain liquid longer, rising to shallow levels in the crust, crystallizing longer and enriching incompatible elements longer prior to eruption. That the magma chambers form at shallow levels probably accounts for the extra-caldera basin-forming subsidence into the magma chamber resulting in the unique geometry of a small closed oval basin containing a caldera in one end. It also suggests there will be rampant hydrothermal alteration by the recruitment of groundwater into hydrothermal circulation cells fueled by shallow magma bodies.

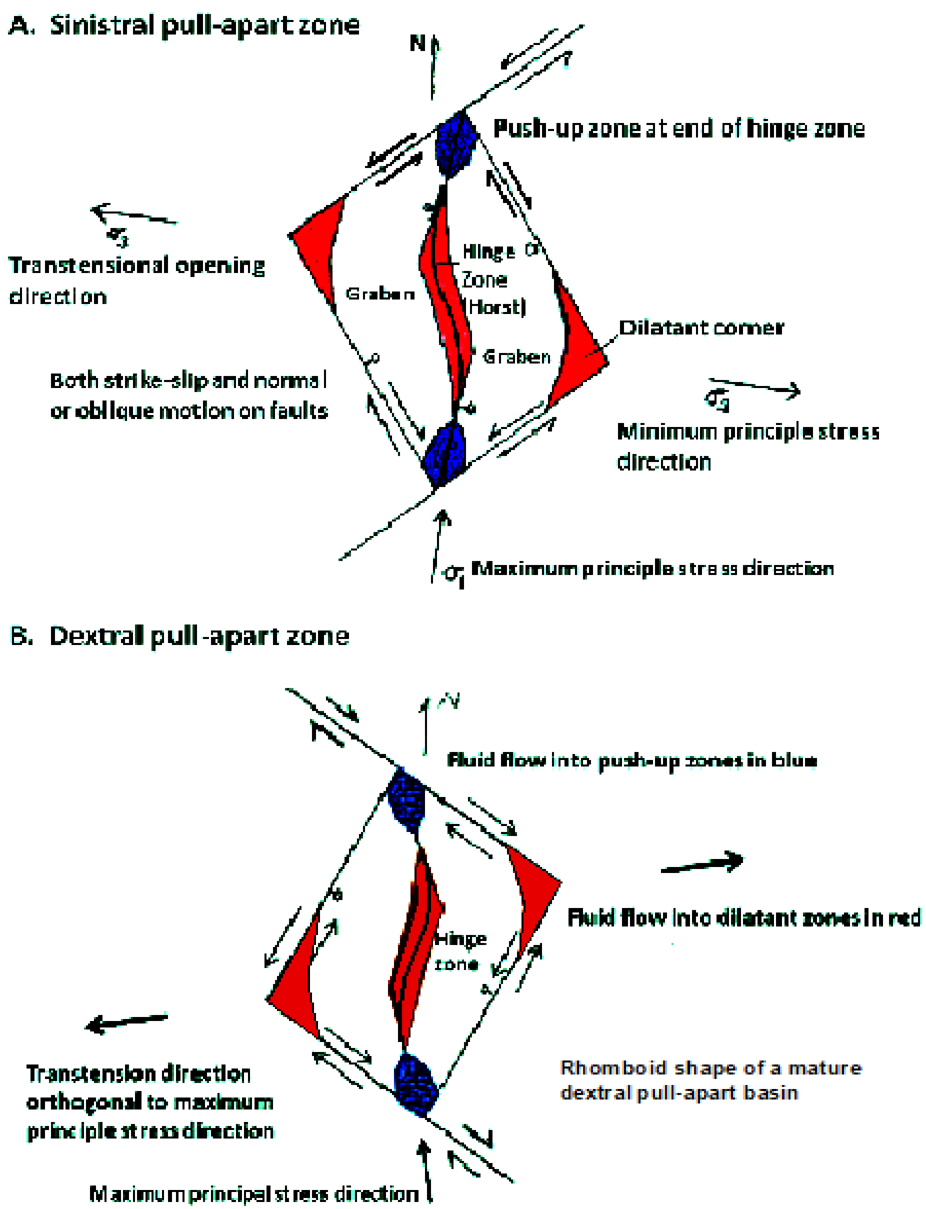


Figure 1. Features expected in pull-apart basins. Hinge zone is a central ridge system that commonly rifts, forming internal basins. Note ends of hinge zones (in blue) are zones of shortening and would delay caldera-forming eruptions.

The location of ancient hinge zones is facilitated by the geometry of a set of spindle-shaped basins and ranges narrow on the edges and bulging outward in the middle. The ranges also experienced significant uplift and commonly the deepest levels of rocks exposed in Nevada are exposed there, such as Precambrian-Cambrian sedimentary rocks and Mesozoic intrusive rocks. Metamorphic core complexes may also be exposed, particularly on the outside of a hinge zone.

That a caldera-basin couplet does not appear to be at the end of a hinge zone does not necessarily mean it did not develop at the end of one. Hinge zones propagated along strike as pull-apart basins enlarged and it is common for the southern ends to host Oligocene –Miocene volcanics while the northern parts had Eocene volcanism.

In the figures that follow on the Clayton Valley area, numerous strike-slip and normal faults have been interpreted by American Metals Exploration Corp, primarily from gravity data. The faults define small narrow pull-apart basins that cut through calderas. Such faults probably also controlled the geometry of the volcanotectonic rift basins that formed with the calderas. Indeed, movement along these faults likely was the trigger cracking the lid and releasing pressure leading to catastrophic caldera-forming eruptions.

Figure 2 shows three of the main hinge zones in Nevada. In yellow is the Eocene Carlin hinge zone, which has the Diamond caldera (Lithaur’s project) in the northern end. The Oligocene-Miocene Round Mtn. hinge zone, in red, overlapped the west side of the

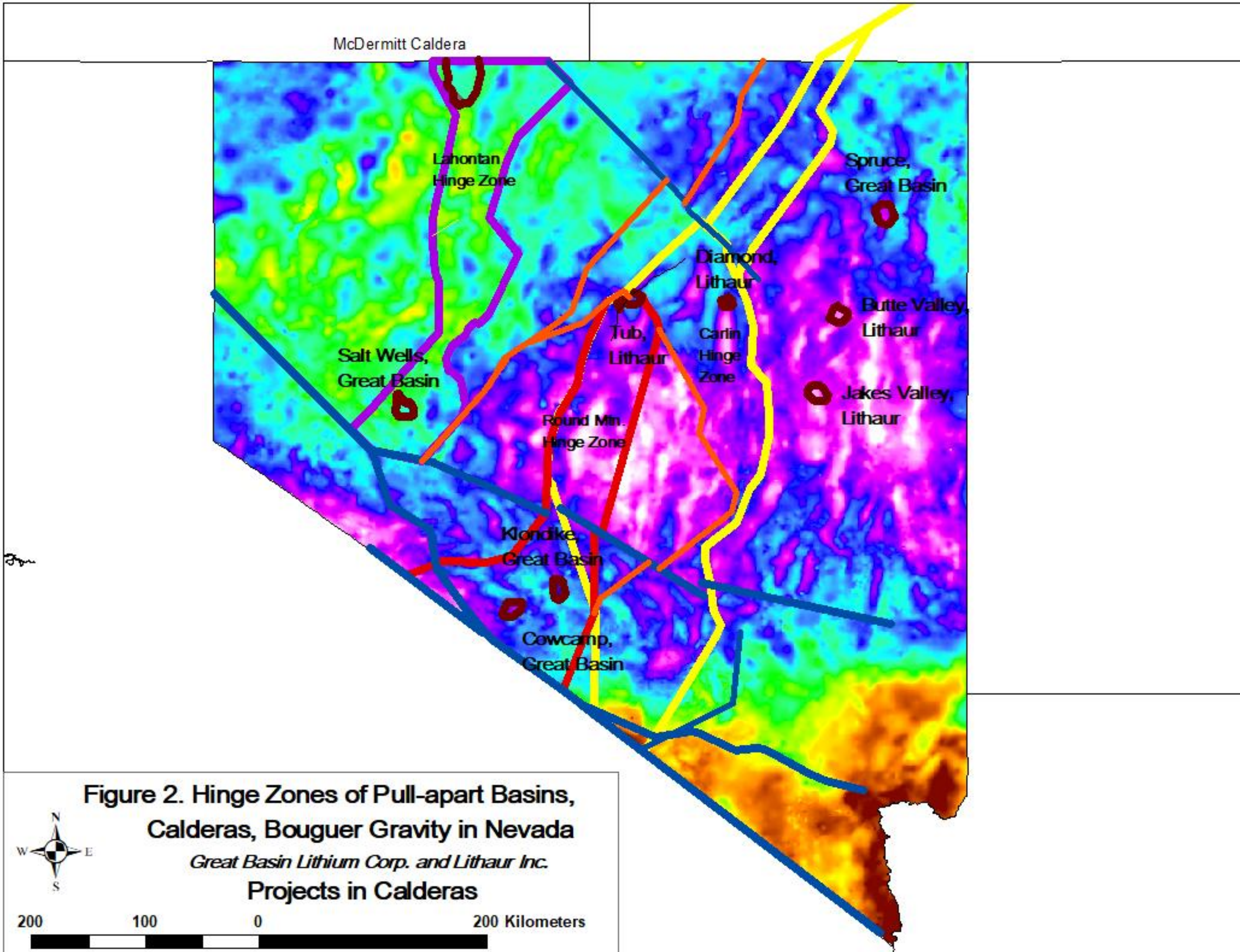


Figure 2. Hinge Zones of Pull-apart Basins, Calderas, Bouguer Gravity in Nevada

Great Basin Lithium Corp. and Lithaur Inc.

Projects in Calderas

Carlin hinge zone, in a dominantly NE-trending Oligocene-Early Miocene sinistral pull-apart basin, which continued south to the current California border where it was highly overprinted by NW-trending Middle-Miocene structures of the Walker Lane. The Clayton Valley deposits formed in the southern end of this hinge zone and the Caetano Caldera (Lithaur's Tub project) formed in the northern end.

A companion basin formed at the same time to the NE, the Lahontan basin, and the Miocene Thacker Pass and Salt Wells lithium-boron deposits formed respectively in the northern and southern ends of the Lahontan hinge zone, outlined in purple in Figure 2.

Clayton Valley Area Projects

The Cowcamp Project is in the southern end of Clayton Valley and the Klondike Project is just over the ridge to the north of Clayton Valley. Figures 3 and 4 show the location, the associated calderas and competitors' land positions. Albemarle's Silver Peak mine is the only currently operating lithium brine mine in North America. It is in a small closed valley outlined by the 1300 m. contour line, in the figures. This valley is fairly young, has a playa/playa lake, and as can be seen in Figure 4, is out-of-synch with the gravity signature below it, i.e. there is no gravity low suggesting a basin beneath it. The reason for that is that the gravity high below it is due to an E-W trending mid-Miocene uplift which deformed the earlier Early Miocene rift basin and Clayton Valley caldera and severed the northern end of the rift basin, which in now the small basin in the SW of the Klondike project area.

The dashed thick brown lines outline the inferred outer ring fractures/basin boundaries of the Early Miocene Clayton Valley caldera. The present small valley that hosts the Silver Peak mine is interpreted here to be a successor basin that reactivated the Early Miocene basin faults.

Albemarle is primarily pumping lithium brine from aquifers in the southern part of the mine and decanting and concentrating it in a series of evaporation ponds to the north. Albemarle acknowledges an evaporative component to the brines from isotopic evidence but notes that the aquifers of felsic volcanic ash and clay may play an important role for the lithium component. It is possible that Albemarle is pumping out of aquifers that were elevated by the mid-Miocene uplift and are connected to the basins indicated by gravity lows to the south in the caldera. These basins are covered by Pure Energy Minerals, which is in the development stage of a lithium brine mine, and other companies, including American Metals Exploration Corp. which are in exploration stages, and whose property positions are shown in figures 3 and 4. As can be seen with the pink/purple colors in Figure 4, there are two main gravity lows (basins) in the caldera - Pure Energy Minerals has the one to north covered and American Metals Exploration's Cowcamp Project has the one to the south covered, and there appears, based on the gravity, to possibly be a connection between the two. It is inferred that lithium brines formed by surface evaporation, because of their high density compared to groundwater, will migrate to the lowest parts of basins and to the lowest basins if they are interconnected.

Great Basin's Klondike project is in a similar basin/caldera configuration to the north and will be discussed first and then the Cowcamp project.

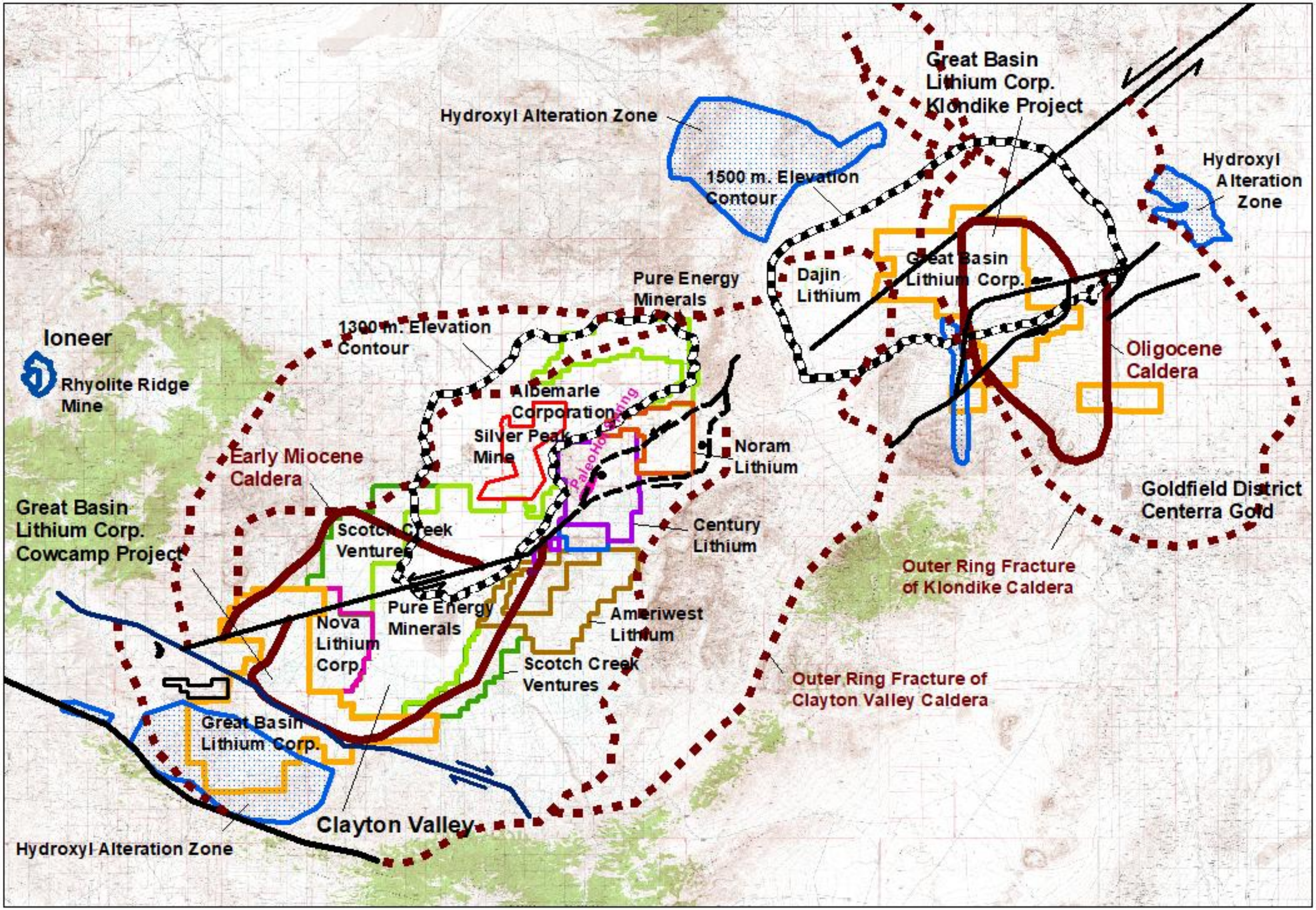


Figure 3. Cowcamp and Klondike Projects, in and near Clayton Valley, NV: Topographic map, land positions. Great Basin Lithium Corp.'s claim blocks in gold

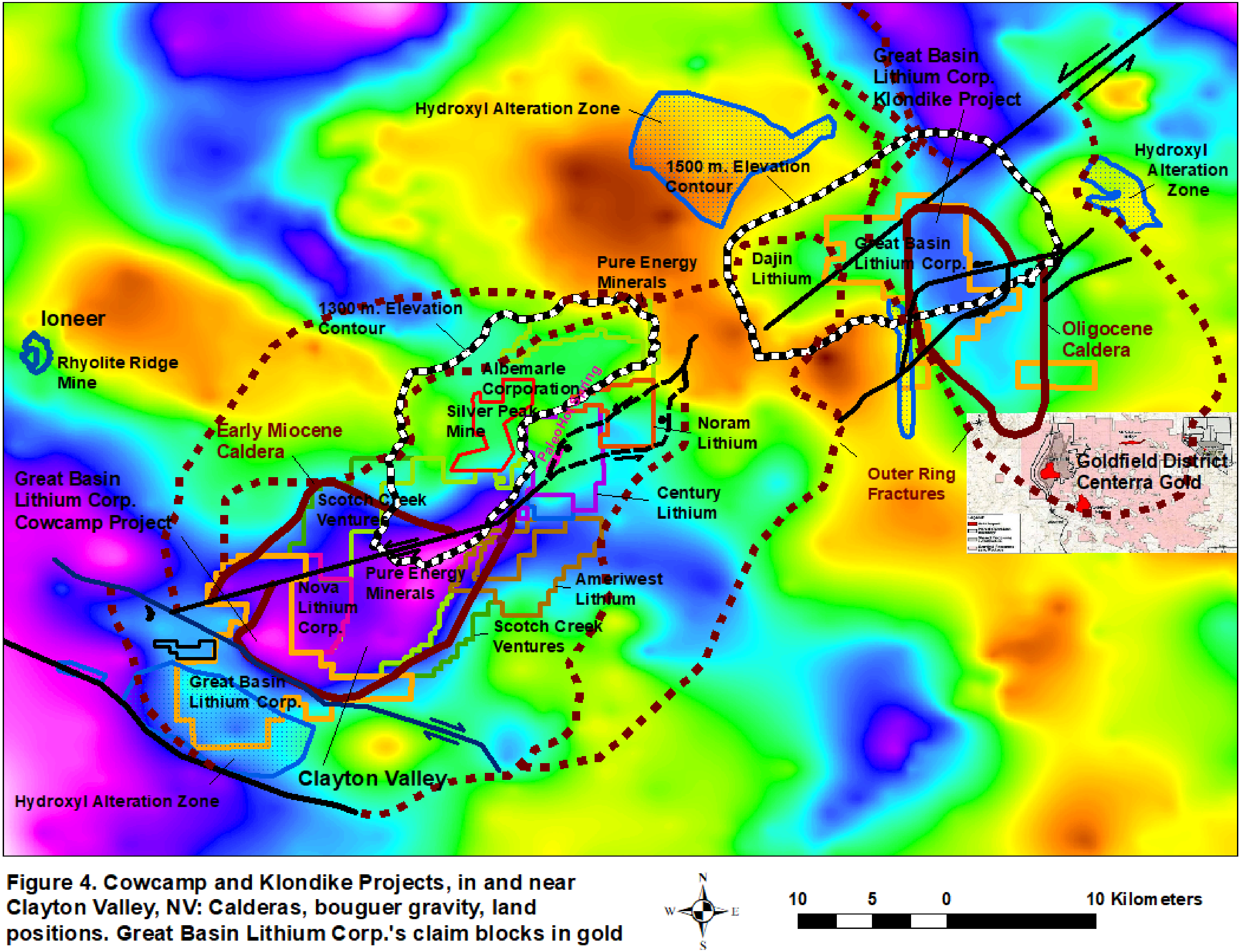


Figure 4. Cowcamp and Klondike Projects, in and near Clayton Valley, NV: Calderas, bouguer gravity, land positions. Great Basin Lithium Corp.'s claim blocks in gold

The Klondike project is in what American Metals Exploration has identified as an Oligocene-age caldera associated with the similar-age gold mineralization in the Goldfield district along the south rim of the caldera outer ring fracture (see Figure 4). There are other areas to the NW and NE of the caldera which also have very abundant historical mines and prospects and are suggested to have some form of strong hydroxyl alteration from the Landsat image in figures 5A and B.

The captions for figures 5-10 are detailed and will not be repeated here. It is important to note that hydrothermal alteration is recognized as associated with and probably necessary for the formation of ore-grade lithium clays. The same hydrothermal fluids adding lithium to lacustrine clays could also be responsible for epithermal gold deposits in volcanic rocks and underlying bedrock in and adjacent to calderas.

An ideal situation would be a lithium clay deposit overlying a gold deposit, the upper part of the pit paid for to get to the gold deposit. The detailed gravity survey (depth to basement grid) provided by Dajin Lithium on its website, suggests hydrothermal alteration rather than deep basins, as detailed in the figure captions. At Klondike, there appears to be an E-W alteration corridor emanating from a buried igneous body inferred from magnetics. This corridor could host both lithium clay and gold deposits.

Great Basin has interpreted two small sinistral pull-apart basins from gravity data in the Clayton Valley area. The one to the south is associated with a paleo hot spring and lithium clay resource identified by Century Lithium at its Clayton Valley deposit (see Figures 5 and 9). A similar structural setting at Klondike is adjacent to the still-warm Alkali hot spring.

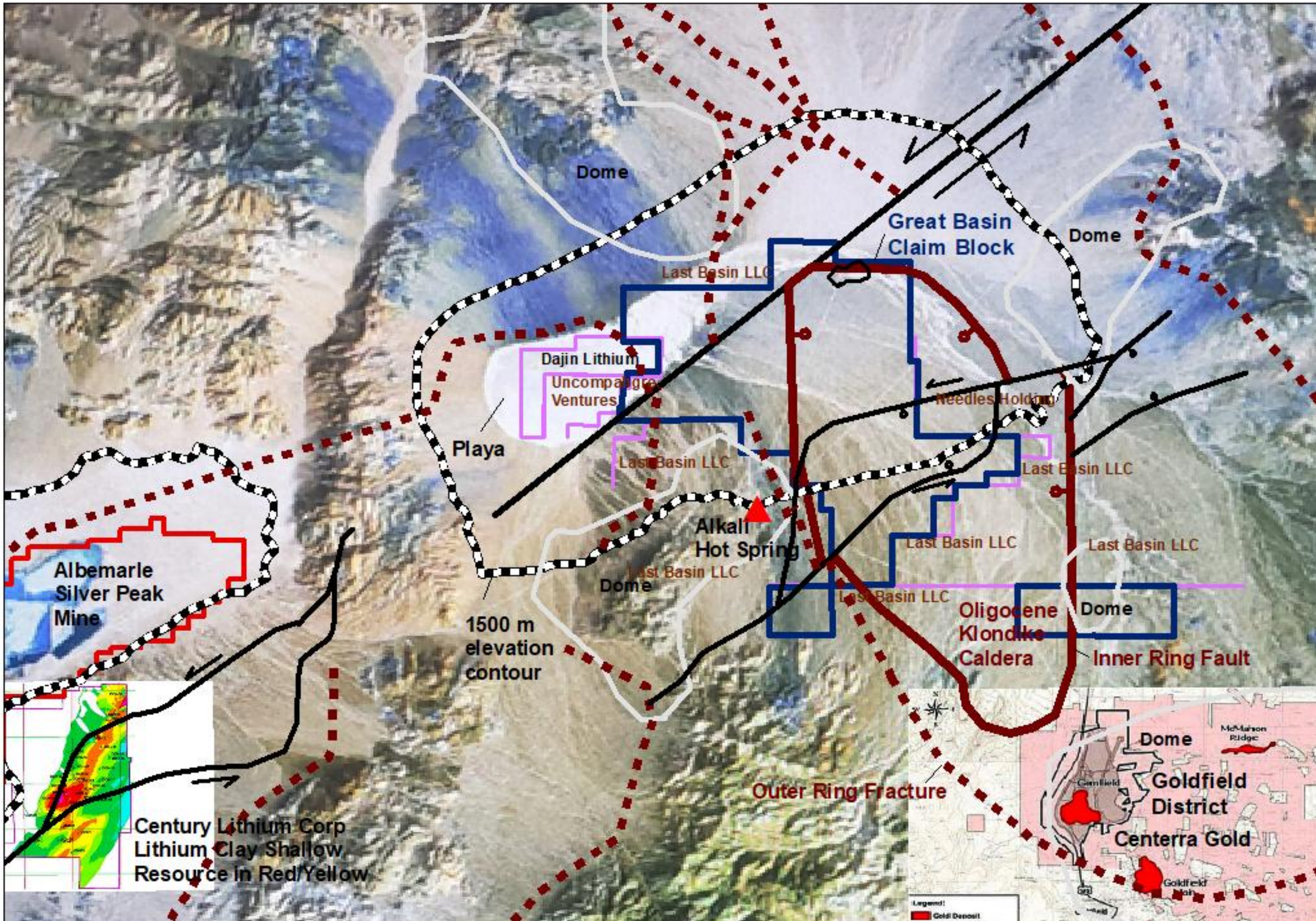


Figure 5A. Klondike Project. Closed basin with playa over buried resurgent caldera. Background is Landsat natural color image enhanced with blue infrared. Blue color highlights water, e.g. Silver Peak ponds to SW, and also hydroxyl-bearing minerals such as clay, sericite or chlorite. Blue zones around Klondike caldera likely indicate hydroxyl alteration.

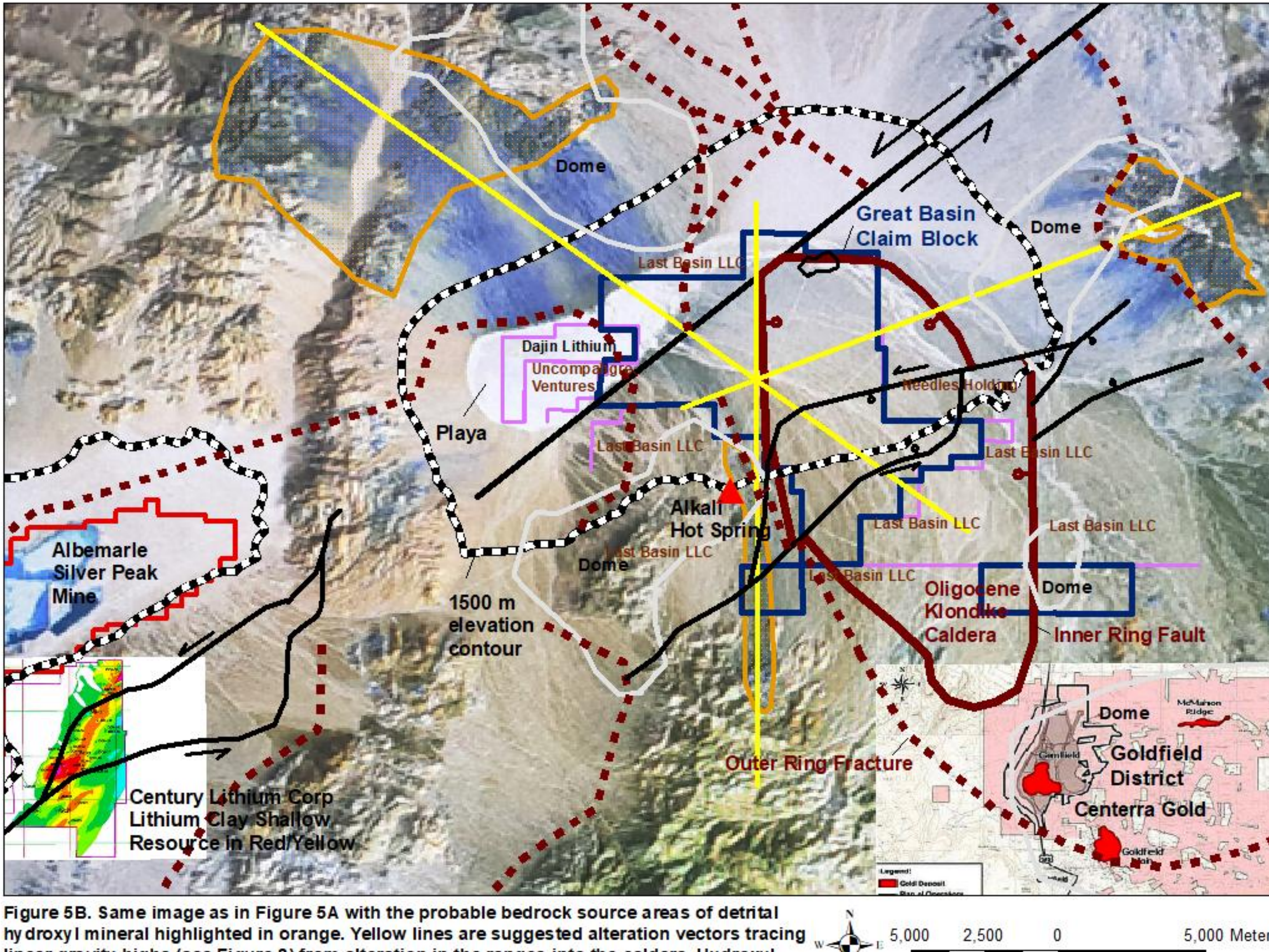


Figure 5B. Same image as in Figure 5A with the probable bedrock source areas of detrital hydroxyl mineral highlighted in orange. Yellow lines are suggested alteration vectors tracing linear gravity highs (see Figure 8) from alteration in the ranges into the caldera. Hydroxyl alteration in the range may be peripheral to higher grade alteration in the core area.

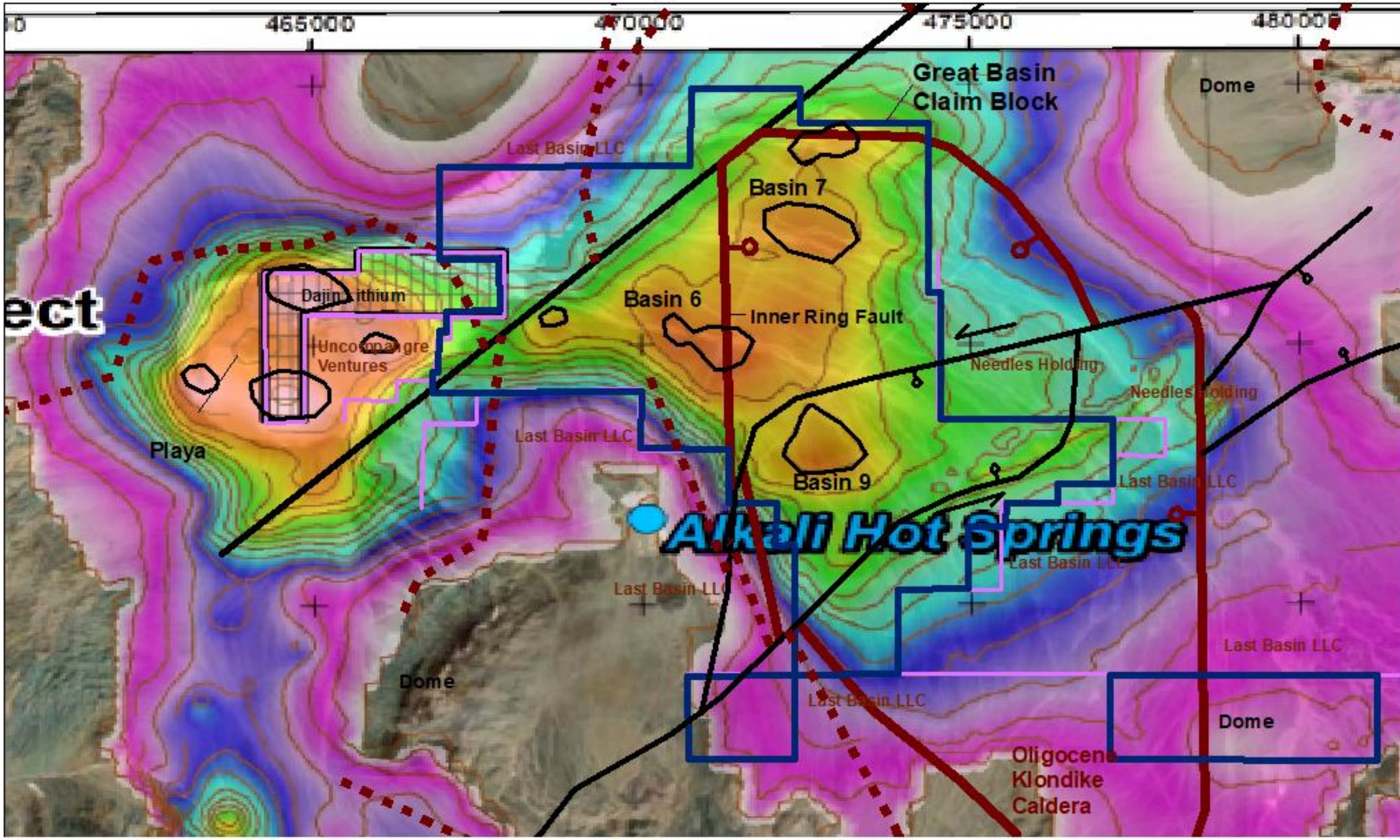


Figure 6. Depth to bedrock interpreted from detailed gravity survey - pink/red colors suggest deeper bedrock. Interpreted basins outlined in black. Color scheme suggests that bedrock under Basin 6 is deeper than under Basin 9, based on assumption the gravity lows are strictly due to thickness of alluvium. As shown in Figure 7, the regional gravity data suggest a steep drop off of bedrock east of the inner ring fault, and bedrock below Basin 9 would be deeper than below Basin 6.

Klondike Project

Great Basin Lithium Corp.

Color Grid is Depth to Bedrock,
map from Dajjn Lithium Corp. website

N
W E
S

4,000 2,000 0 4,000 Meters

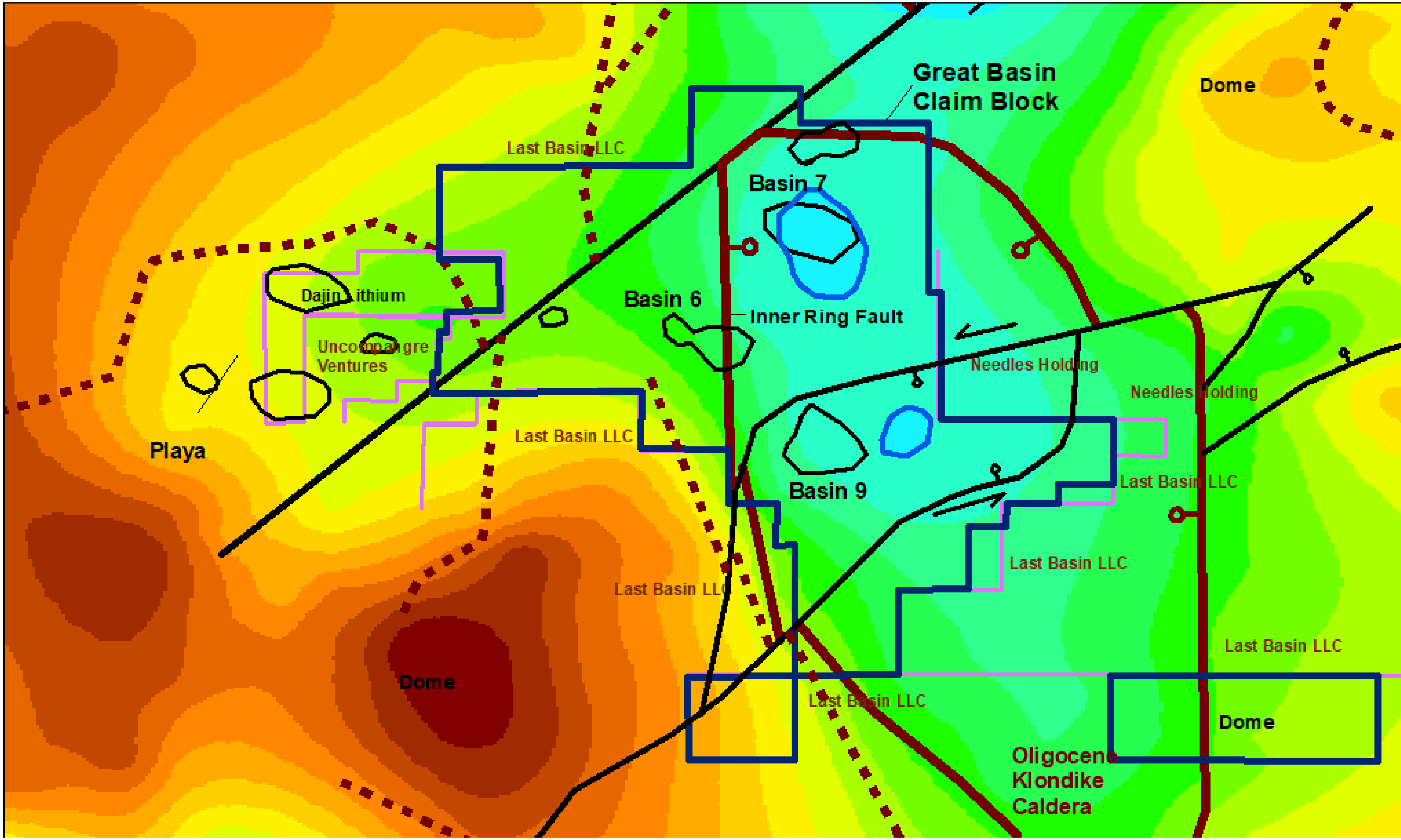
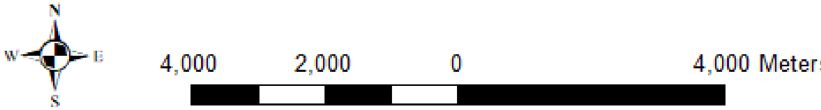


Figure 7. Complete Bouguer Gravity Anomaly - brown color denotes gravity highs, blue color indicates gravity lows. Note significantly lower gravity values on east side of inner ring fault than on west side - suggests depth to bedrock greater on east side of fault. Small basins within the larger basin are outlined in blue and correspond well with the easternmost basins outlined from Dajin's detailed gravity survey, supporting that Basin 7 and Basin 9 may be deep basins. Gravity low at Basin 6 is interpreted here to reflect hydrothermal alteration.

Klondike Project

Great Basin Lithium Corp.

Color Grid is Complete Bouguer Gravity Anomaly
regridded by minimum curvature from 1997 USGS data



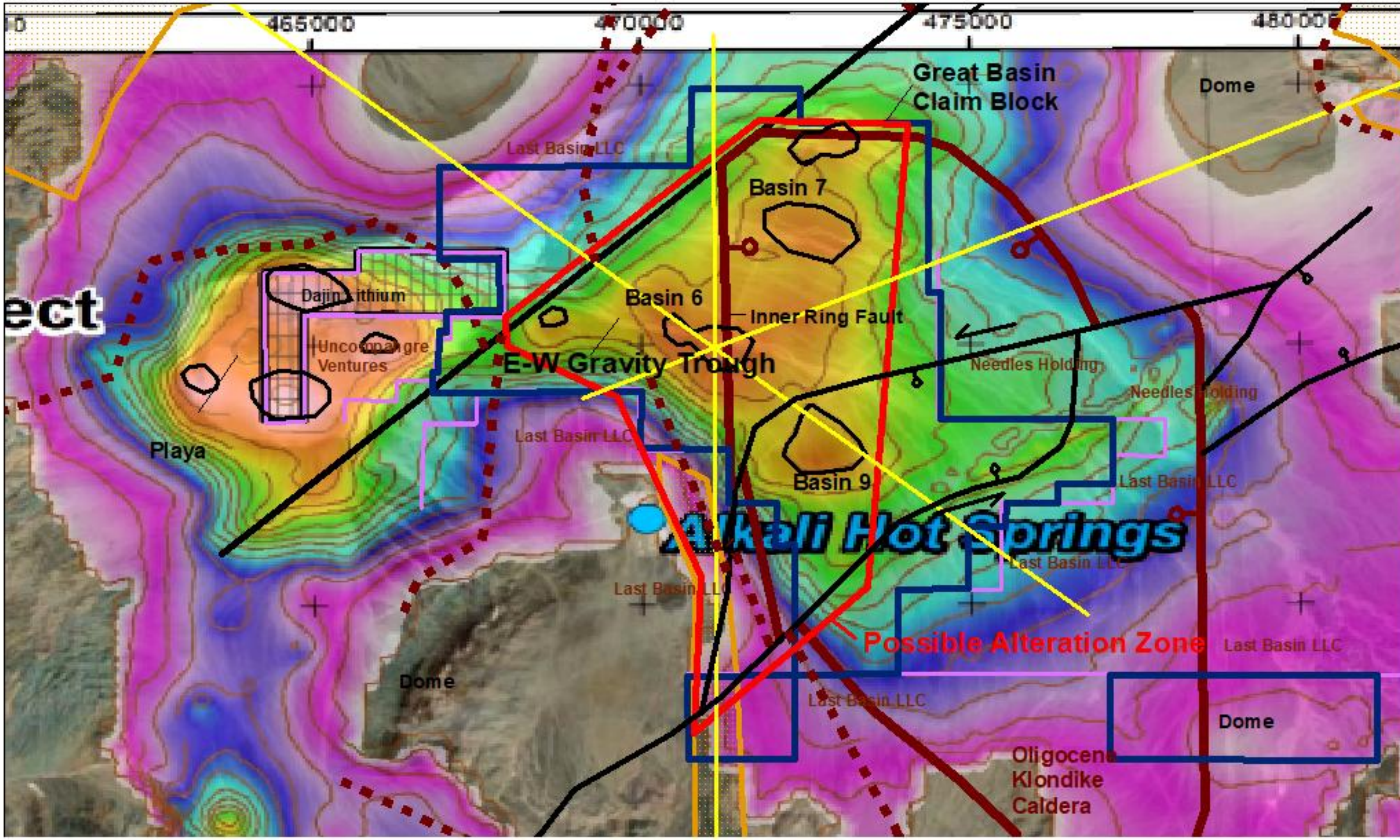
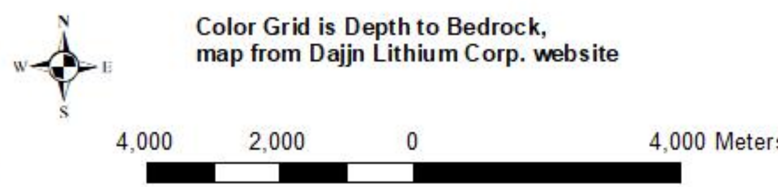


Figure 8. After Figure 6. The interpretation that the gravity lows are solely due to thick alluvium would suggest that the E-W trough of gravity lows is a buried canyon carved by a stream flowing east. Yet this canyon is headless - there is a basin suggested to be 4,000 ft deep where the headwater stream channel should be. This gravity trough is here interpreted to be a linear zone of hydrothermal alteration. The yellow lines are alteration vectors from the hydroxyl alteration zones in the range and intersect in the area of Basin 6, the possible core of the alteration zone, which is outlined in red.

Klondike Project

Great Basin Lithium Corp.

Color Grid is Depth to Bedrock,
map from Dajjn Lithium Corp. website



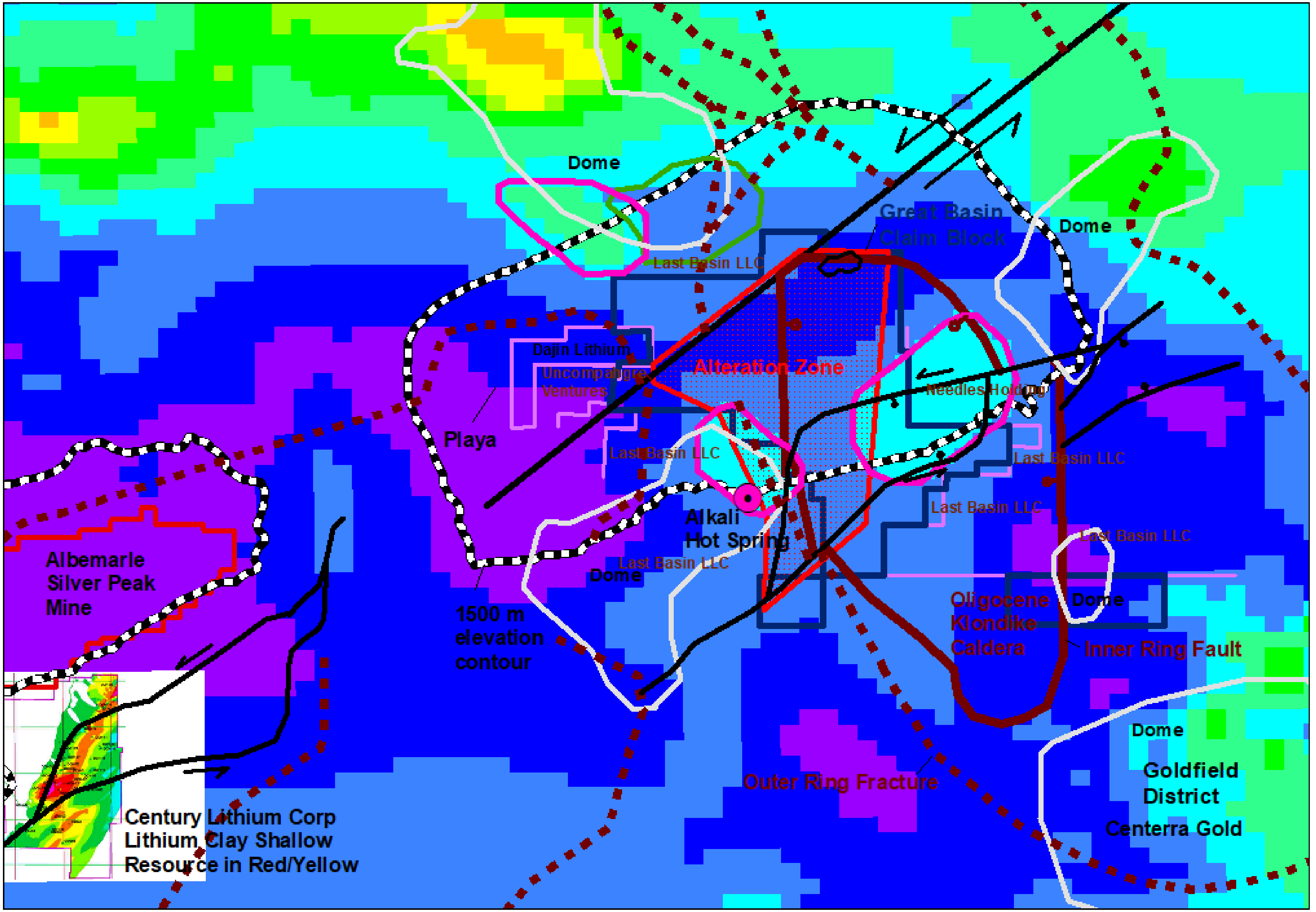


Figure 9. Klondike Project. Colored background is Total Magnetic Intensity from aeromagnetic data by the USGS (2006). Green to brown colors are highs, blue to purple colors are lows. Note three moderate high anomalies in and adjacent to the Klondike caldera - outlined in pink. Siimilar magnetic highs at Goldfield are associated with outcropping Miocene-age andesite around the outer ring fracture.

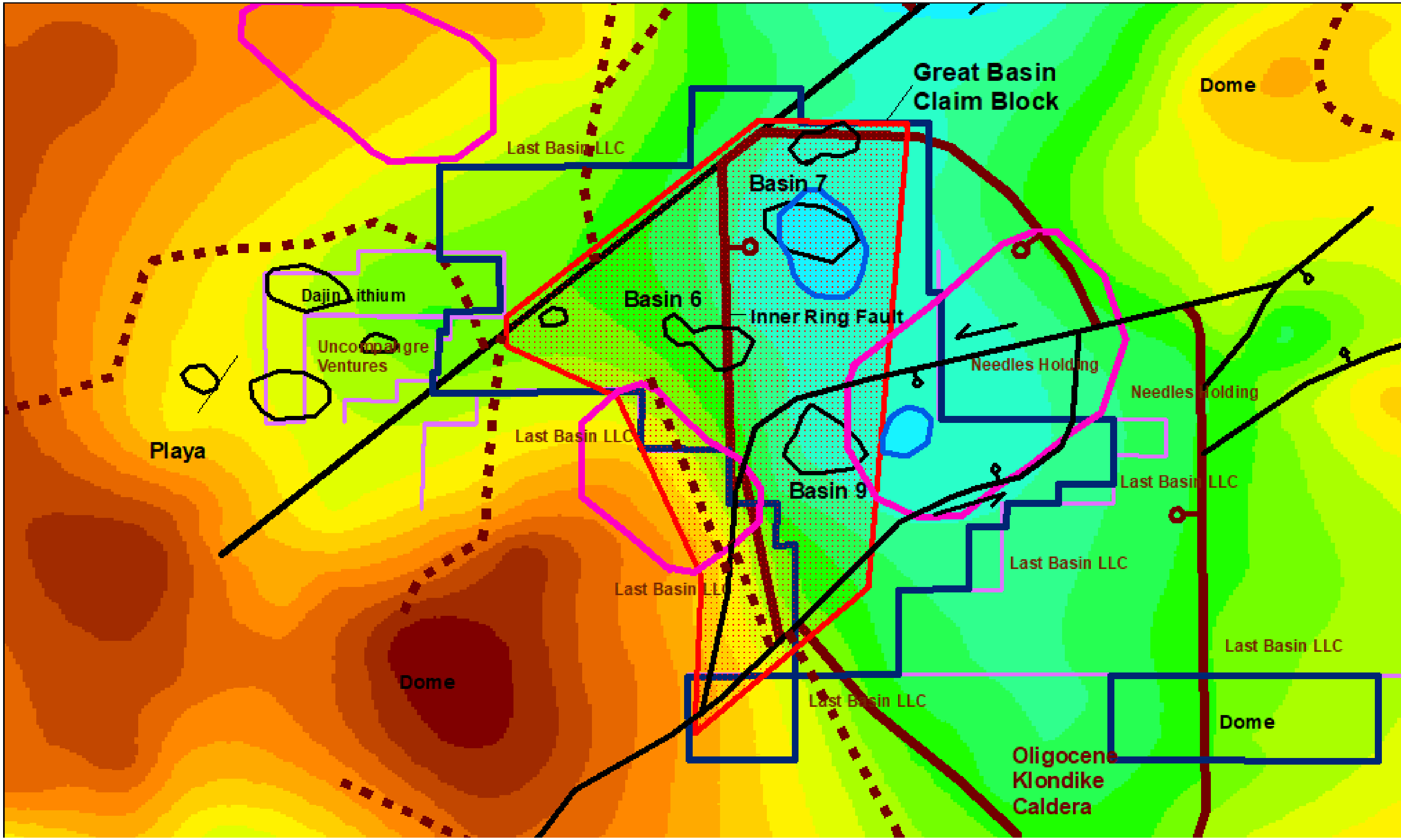


Figure 10. Complete Bouguer Gravity Anomaly - brown color denotes gravity highs, blue color indicates gravity lows. Pink outlines are aeromagnetic highs that may be Miocene andesite bodies and may have been heat engines for circulating hydrothermal fluids. Red dotted pattern outlines suspected hydrothermal alteration zone which could host both lithium clay and gold deposits. Lithium brines are expected to have migrated to the lower parts of basins, outlined in black and blue.

Klondike Project

Great Basin Lithium Corp.

Color Grid is Complete Bouguer Gravity Anomaly regridded by minimum curvature from 1997 USGS data

N W E S

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The recognition of probable hydrothermal fluid circulation may also be important for lithium brine formation. It is recognized that felsic volcanic ash is the most likely source for lithium and a caldera and associated basin filled with ash from the caldera-forming eruption is probably the ideal situation for a lithium source. However, if hydrothermal fluids leached lithium out of ash, it wouldn’t matter for an evaporative deposit if the hydrothermal fluids never made it to the surface. Also a single pass of a hydrothermal fluid through volcanic ash seems unlikely to generate an ore fluid of lithium. Lithium clays may be inundated by single-pass hydrothermal fluids for extended periods to obtain ore-grade lithium concentration and the fluids in their own right would not be ore.

A recirculation system, bringing hot pregnant fluid to the surface, and then returning it cool to the basin where it is again reheated, convected again upward through volcanic ash would fill the bill. Such a scenario may take place with hot springs on domes where buoyant hydrothermal fluid rises to the highest level affordable before it cools and sinks, only to go back into the closed basin.

Klondike, Cowcamp, Salt Wells and all the Lithaur projects have this potential. Diamond is unique in having another type of circulation system. It had in the past extensive arrays of artesian springs where aquifers were probably bringing deep water to the surface by the pressure of copious groundwater water above.

Cowcamp is discussed in figures 11 and 12 and Salt Wells in figures 13-17.

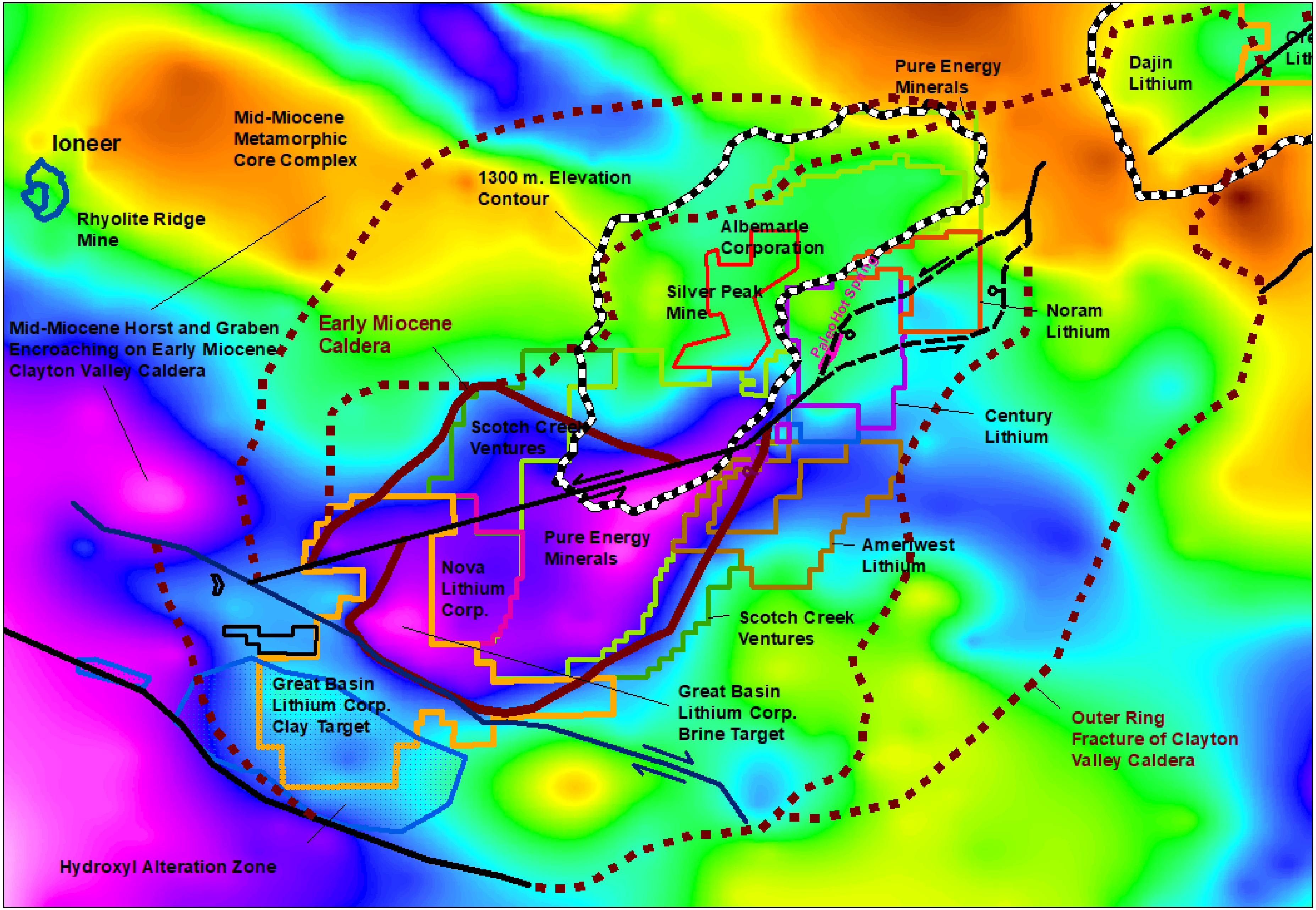

Figure 11. Cowcamp Project - Bouguer Gravity. Pink/purple zones are gravity lows - probable basins. Great Basin's claim block outlined in gold and main lithium brine and clay targets indicated.

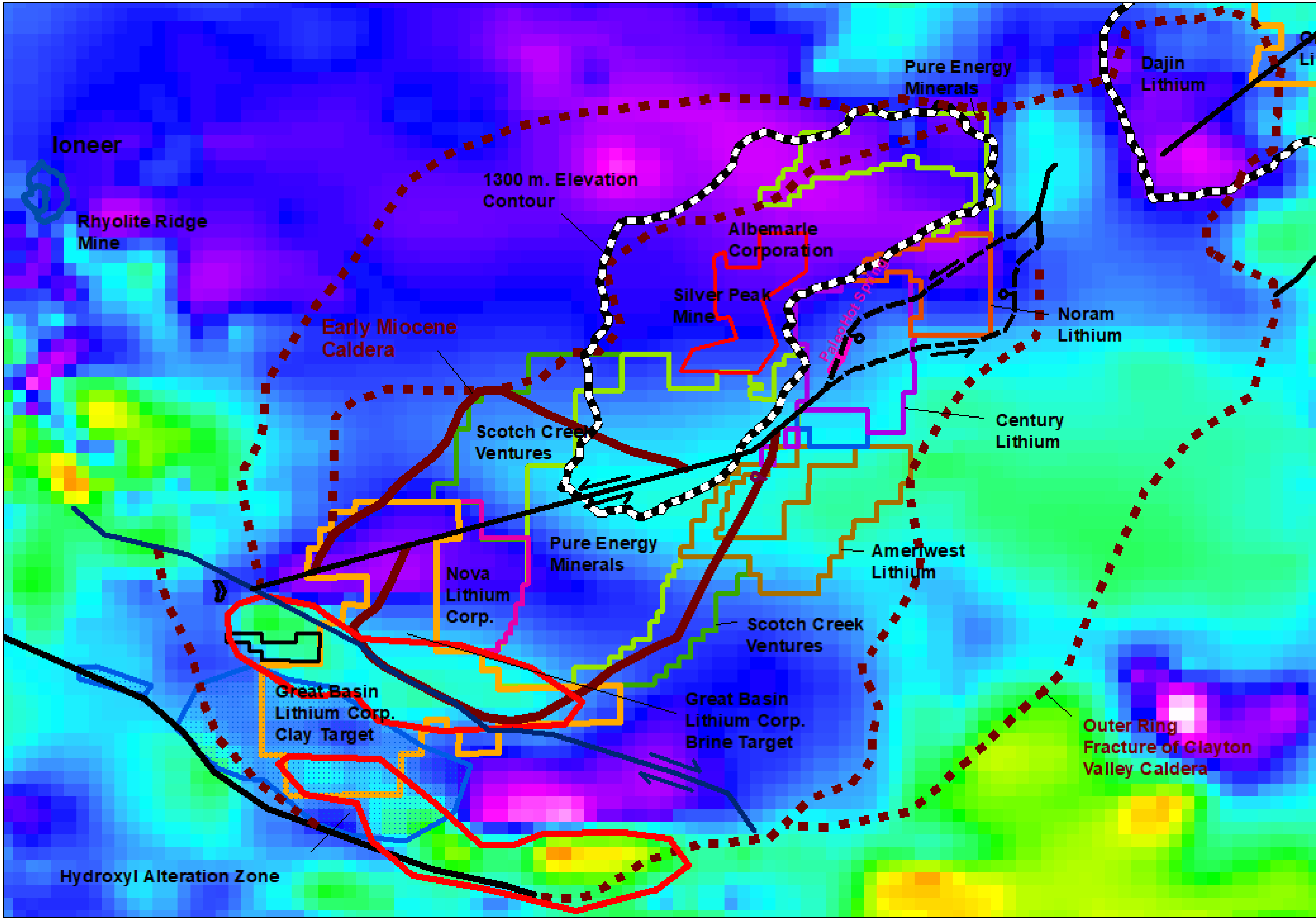

Figure 12. Cowcamp Project - Aeromagnetic map. Linear magnetic highs in the south are outlined in red - due to andesites intruded along the ring fractures: heat engines for hydrothermal circulation.

Salt Wells is another closed basin with a playa inside a caldera. The caldera is Miocene in age and developed at the southern end of the Lahontan hinge zone (see Figure 2) in the Lahontan pull-apart basin. It is similar in age to the McDermitt caldera which sits in the same position at the opposite end of the Lahontan hinge zone. Tectonically, Salt Wells is very similar to Clayton Valley, at the southern end of an Oligocene-Miocene hinge zone.

The Salt Wells site was an historical borax mine and the northern part of the playa is currently being developed by the Australian company Osmond Resources for boron salt with lithium as a byproduct. Osmond has reported up to 810 ppm Li and >1% B in salt. Lithium partitions into salt very poorly, so it is likely that the residual brine after salt precipitation is enriched in lithium.

Part of the site is also being developed for geothermal power, an indication that hydrothermal fluid circulation is still active.

The potential for a lithium-boron brine appears to have been overlooked by competitors, and the gravity low in the caldera is mostly open ground. American Metals Exploration Corp. plans to stake this as soon as possible. Figures 13-17 show the caldera, the planned placer claim block, and gravity and magnetic signatures. There are also indications of significant hydrothermal alteration by an hydroxyl alteration zone to the east (see Figure 15) and the Dan Tucker Gold Mine at the gold circle in the figures. The coincident gravity and magnetic highs adjacent to the proposed claim block suggest a central resurgent dome of andesite, which may have produced hydrothermal circulation of lithium brine through caldera-fill felsic ash.

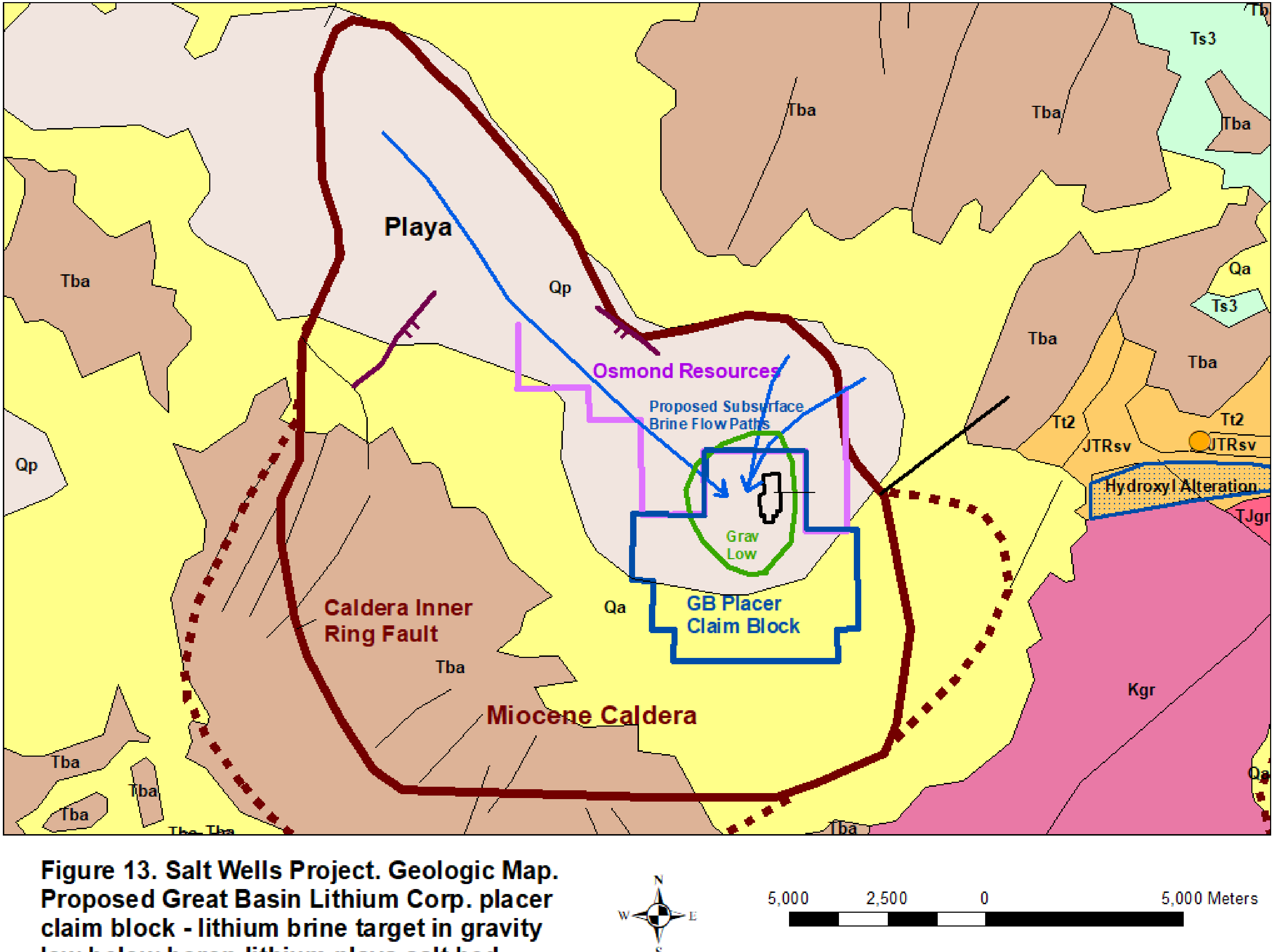

Figure 13. Salt Wells Project. Geologic Map. Proposed Great Basin Lithium Corp. placer claim block - lithium brine target in gravity low below boron-lithium playa salt bed

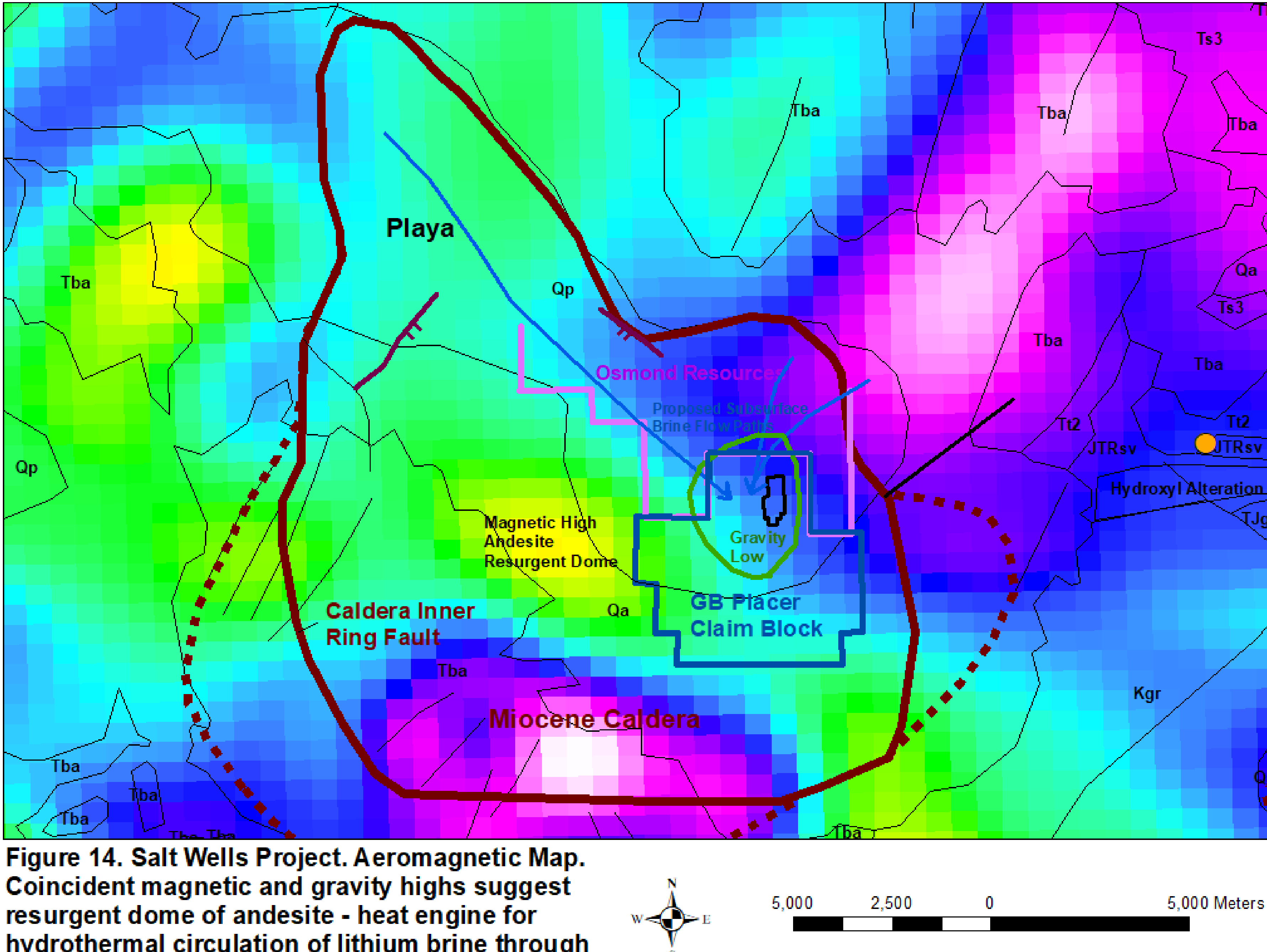

Figure 14. Salt Wells Project. Aeromagnetic Map. Coincident magnetic and gravity highs suggest resurgent dome of andesite - heat engine for hydrothermal circulation of lithium brine through caldera-fill ash

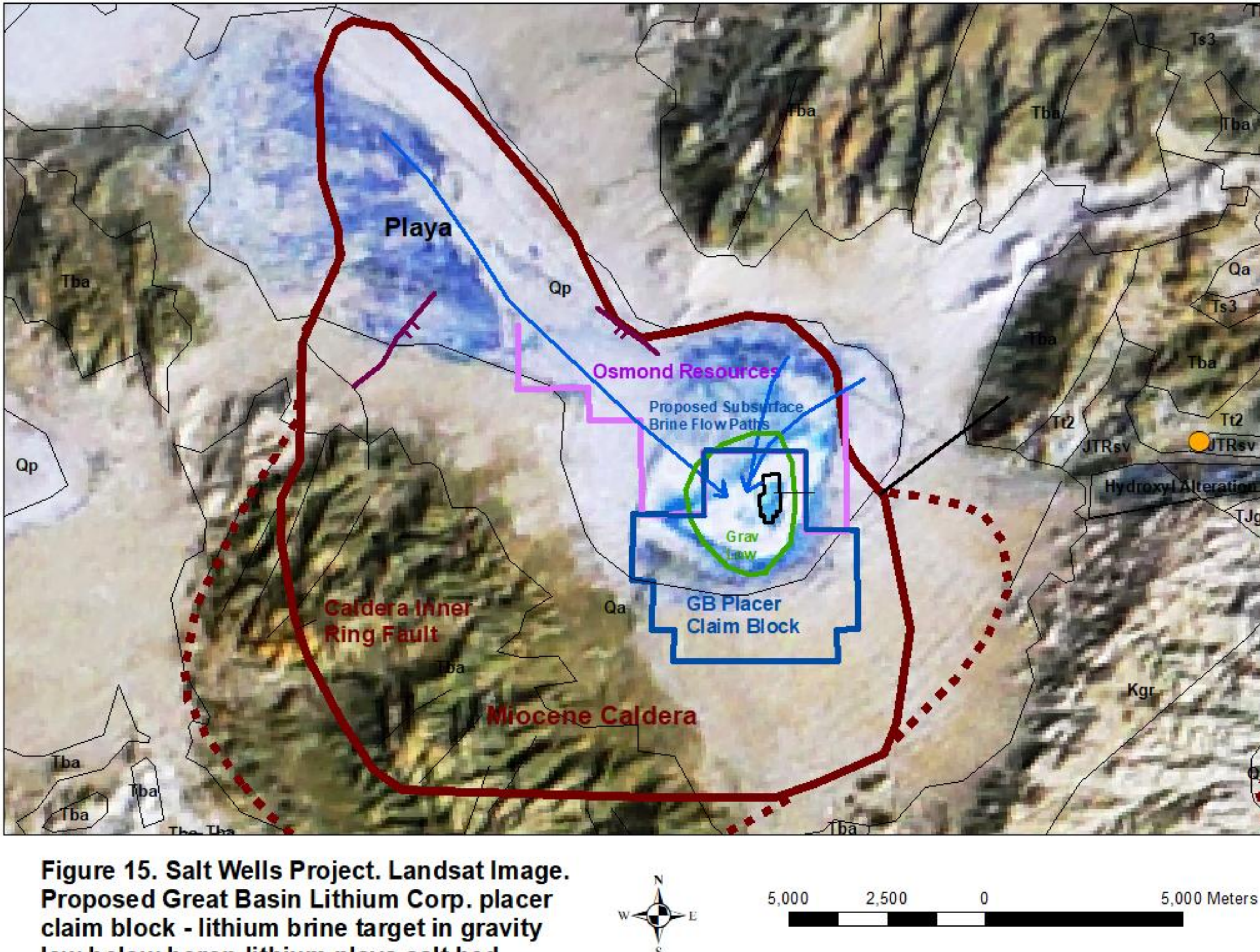

Figure 15. Salt Wells Project. Landsat Image. Proposed Great Basin Lithium Corp. placer claim block - lithium brine target in gravity low below boron-lithium playa salt bed

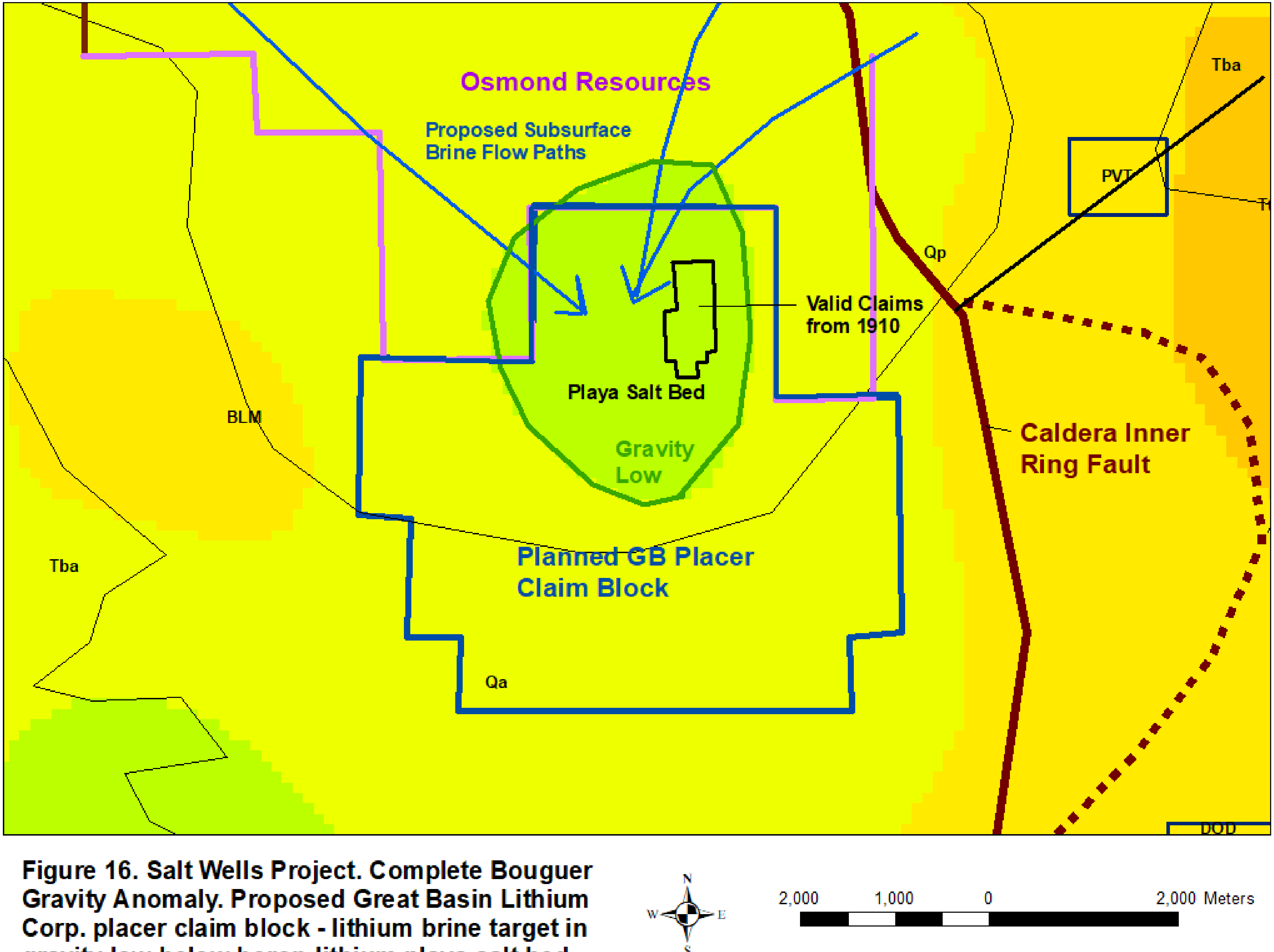

Figure 16. Salt Wells Project. Complete Bouguer Gravity Anomaly. Proposed Great Basin Lithium Corp. placer claim block - lithium brine target in gravity low below boron-lithium playa salt bed

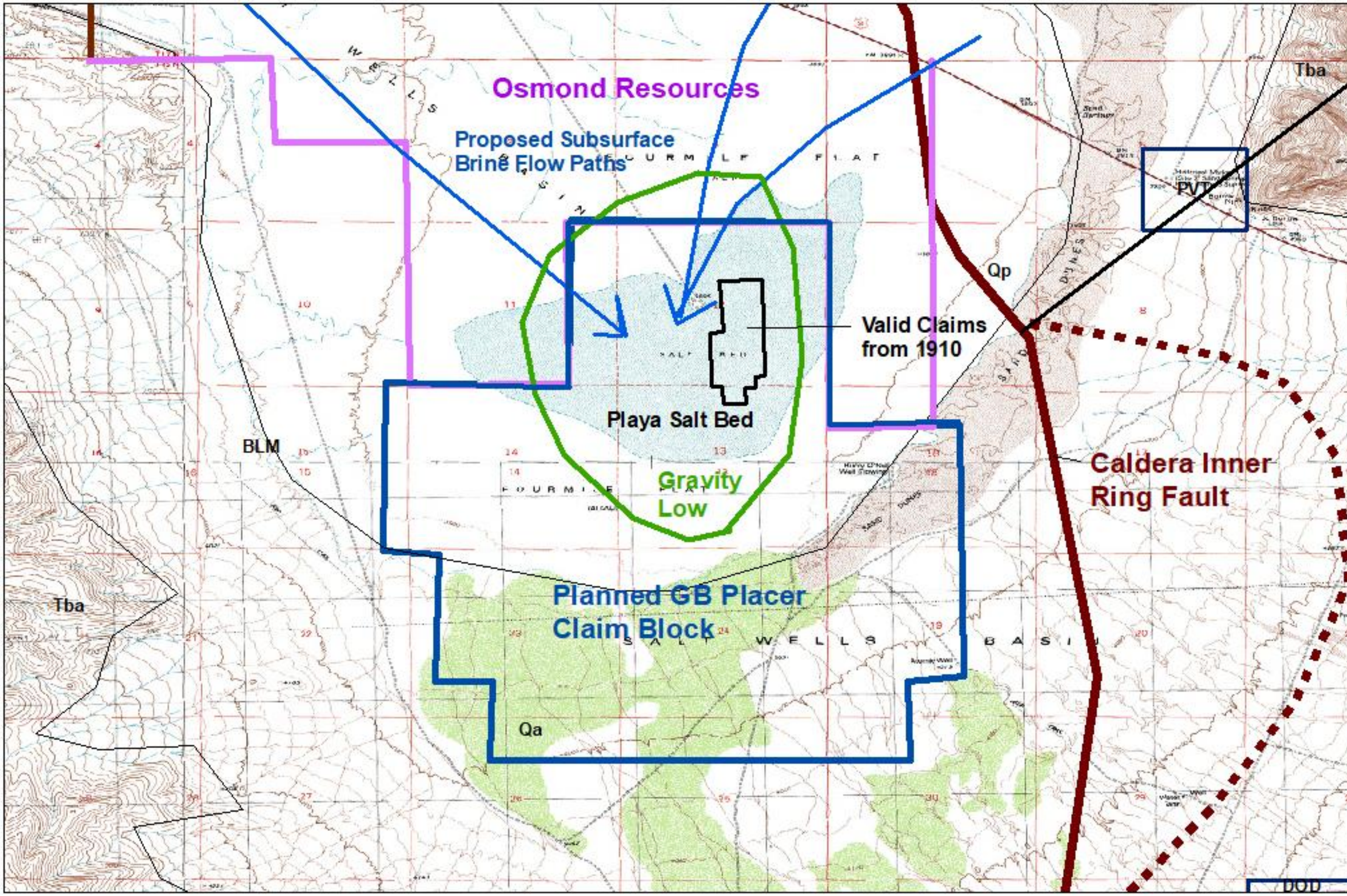

Figure 17. Salt Wells Project. Topographic map. Proposed Great Basin Lithium Corp. placer claim block - lithium brine target in gravity low below boron-lithium playa salt bed