Interim Report
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The Red Feldspar Project

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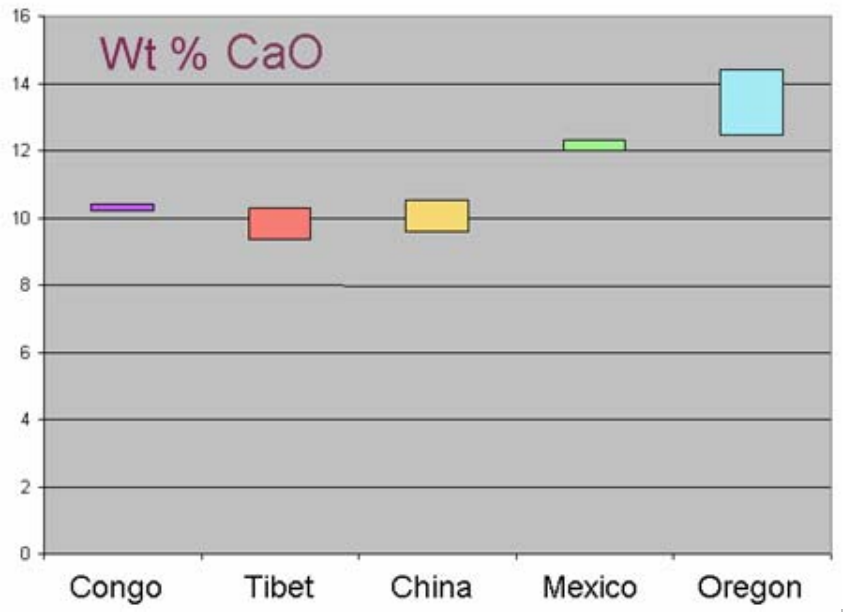
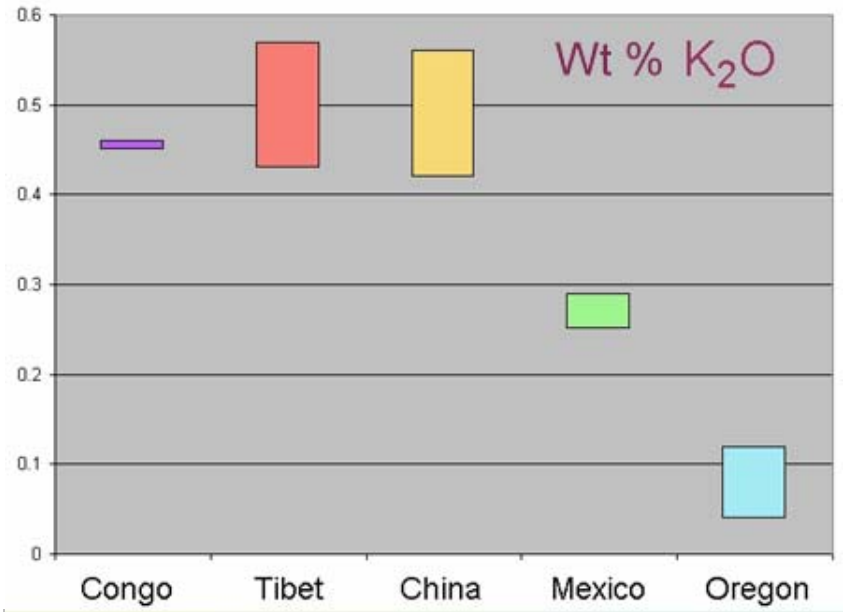
Chemical Analyses

Electron microprobe analyses are an accurate way of determining the composition of the stones. These analyses, summarized below, show that Oregon feldspar is more calcic than the Mexican feldspar from Casas Grandes, which, in turn, is more calcic than the feldspars represented as being from either the Congo, Tibet or Inner Mongolia. The samples said to be from Asian localities and the Congo cannot be distinguished on the basis of major elements.





The yellow Inner Mongolia feldspar does not contain copper. Both red and green rough and cut feldspars contain copper which is the cause of color.

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Simple Heating Experiments

Heating experiments were attempted with under reducing conditions to see if red color would develop. They showed that yellow feldspar from Inner Mongolia does not turn red upon simply heating.

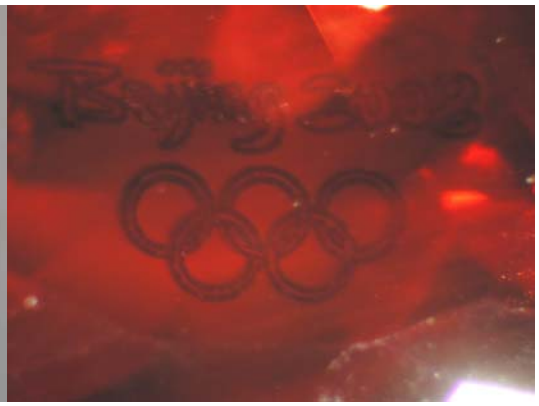
Tumbled feldspar before heating.

After 1250ºC for 5 days in reducing conditions

A Rumor

A Rumor states that Mexican stones are sent to China for diffusion treatment and resold in the US as Chinese feldspar, particularly as the Olympic commemorative feldspar

Mexican Labradorite



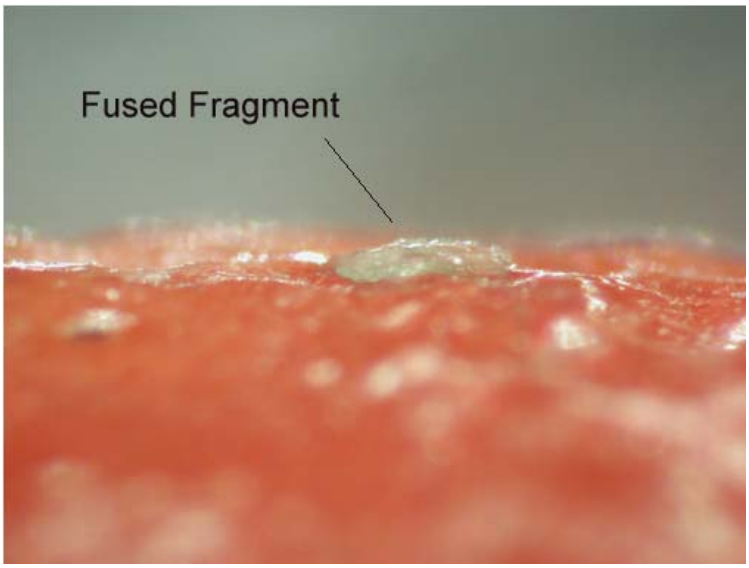
The engraving in an Olympic stone

No Olympic stone tested, to date, has the composition of Mexican feldspar.

Are the Colors Natural?

An assortment of colors observed in these feldspars.

Many rough stones show fragments of material or glass fused to the surface

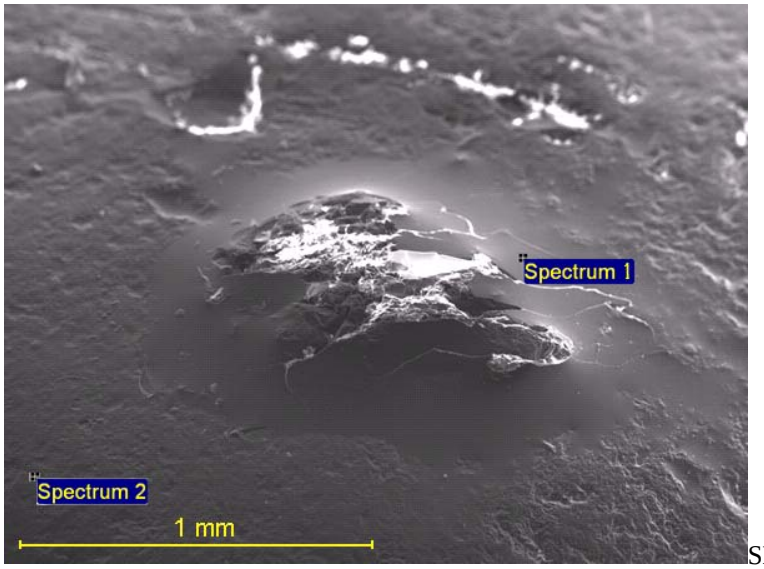


A rough andesine feldspar from Inner Mongolia likely treated by a high temperature process.

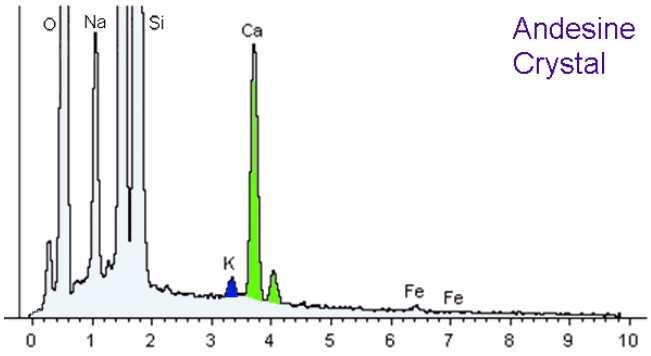
The fused fragments and glass suggest that the stone has been heated to a high temperature such as could occur in a laboratory diffusion process.

Chemical analyses of the glassy area next to the fused fragment can be compared to the chemical analysis of the adjacent feldspar.

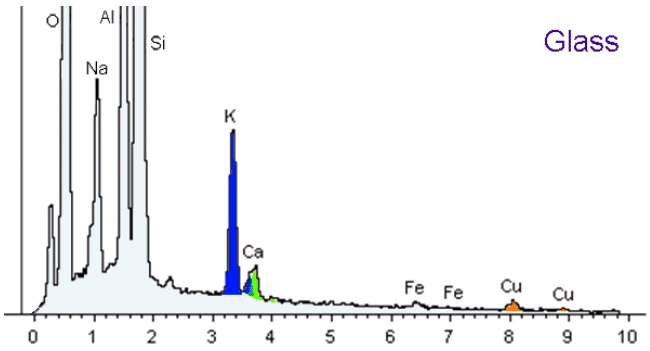
SEM-EDS Analyses



SEM Image Credit: Chi Ma



The feldspar analyzes as feldspar. The copper content is too low to analyze with SEM-EDS analysis.



The glassy area is unlike a natural volcanic glass. It is elevated in potassium and contains a significant amount of copper.

Do Stripes of Color Prove Artificial Diffusion?

Stripes can also be found in Oregon feldspar known to be natural.

China

Oregon

Such stripes can occur naturally from “pipe” diffusion and are not proof of laboratory diffusion.

Diffusion of Copper Does Occur In Ceramics

The red color in this ceramic is caused by the diffusion of copper into the ceramic from a pigment particle.

Laboratory Tests of Diffusion

Diffusion tests were conducted on various samples of feldspar.

Inner Mongolia

Chihuahua, Mexico

Southern Oregon

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Copper proved very easy to diffuse into feldspar. But not all experiments produced beautiful colors. Here is an example of an experiment that produced too much diffusion and turned the stone nearly black.

We, and several others, have shown that it is possible to diffuse copper into feldspars.

Just Because It Can Be Done Is Not Proof That It Is Done.

The question becomes, "how can we prove whether or not the red gems have been heated or not after they came out of their initial igneous rock host?"

To do this, we make use of the fact that ^{40}K is a naturally occurring radioactive isotope. Over geologic time, it decays to ^{40}Ar (a gas). The half-life is 1.3 billion years

The heat of a magma drives Ar out of crystals, so no radiogenic argon will build up in these feldspars while they are in the magma chamber. However, once the feldspar cools to near ambient temperature, ^{40}Ar will return over geologic time.

Luckily, there is potassium in the Chinese feldspars of interest.
Their chemical formula is generally $(Na_{0.51}Ca_{0.47}K_{0.02})[Al_{1.44}Si_{2.55}Fe_{0.01}]O_8$.

If such feldspars are heated in a laboratory, the trapped argon will be released at moderately high temperatures.

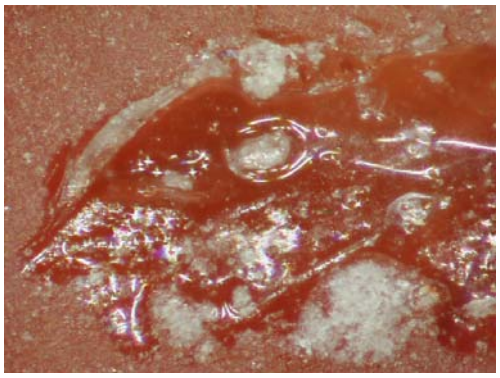
The released argon will have a high ratio of ^{40}Ar to ^{36}Ar (^{36}Ar occurs naturally in air and can also be trapped in feldspars).

Such measurements were made and we find that all the yellow rough, and yellow stones faceted from the rough, have high levels of radiogenic argon that is released when these stones are heated in our laboratory instruments. The levels of radiogenic argon are low (near the atmospheric value ordinary air would have) when red or green faceted stones are heated and when red or green rough is heated.

This is strong evidence that these stones have been heated in recent times at high temperatures. Temperatures such as would be used in diffusion treatments.

Is There a Mine in Tibet That Produces Natural Red Andesine?

The argon release experiment results were the same on all stones we tested from Inner Mongolia or Tibet (or those claimed to have come from the Congo). None of the stones from Tibet (that were obtained from either people who say their family owns the mine or from people who have visited the mine) showed the large amounts radiogenic argon that the yellow, rough Inner Mongolia stones showed.



Stones recently collected (2008) from Tibet also showed fused fragments and glassy material in depressions in the stone.

When tested, the feldspar was what an andesine should be*, but the glassy material was rich in potassium and enriched in copper, just like that found in the treated red feldspar from Inner Mongolia. Also, small particles of copper compounds were found in the glassy material.

*The exception was that, in addition to feldspar, the analysis found fluoride and chloride on the surface of the stones.

The analytical results resemble the treated Inner Mongolia feldspar so closely that they raise doubts about the claim of natural red andesine mines in Tibet.

Conclusion about Tibet Feldspar

Currently, we are unable to reconcile the contradiction between information about the visit to the Tibet mine and the analytical results.