



Determination of Chemical Composition of Red Lithic Artifacts Using X-Ray Fluorescence

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Abstract

This research project analyzed the geochemistry of pre-contact American Indian artifacts from western Wisconsin using Handheld X-Ray Fluorescence (XRF). XRF will determine the distinct chemical composition of the materials used to manufacture these artifacts. This chemical composition can be used to identify the rock type and can potentially be used to identify the precise source of the material.

Background Information

Archaeologists have traditionally relied on visual and physical observations of artifacts to identify their source. Macroscopic characteristics used in such identification include grain size, color, and hardness. The subjectivity of these methods, however, can limit their accuracy.

Archaeologists have recently turned to less ambiguous and more quantifiable means to determine the source of lithic materials. Instrumental analyses have the ability to accurately identify lithic materials by providing unambiguous, quantifiable descriptions of their characteristics. These analytical techniques expose misidentifications proposed by macroscopic methods leading to more accurate research.

X-ray Fluorescence

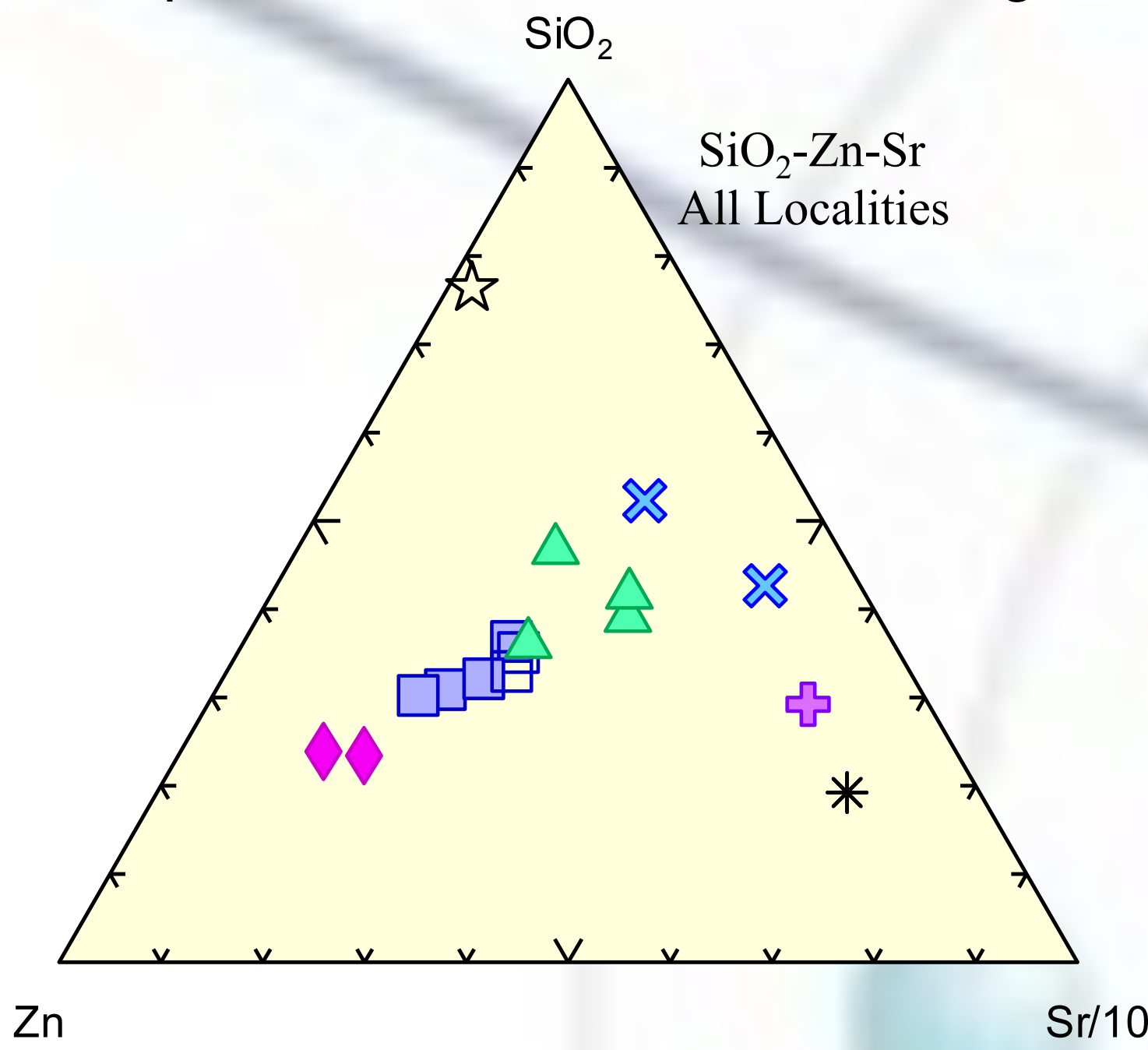
Handheld XRF is nondestructive and requires minimal sample preparation. A single sample requires only four minutes to run. The XRF can simultaneously determine both the major element composition and the trace concentration of elements down to the part-per-million level. Both major and trace element analyses are important for matching artifacts to their unique source.



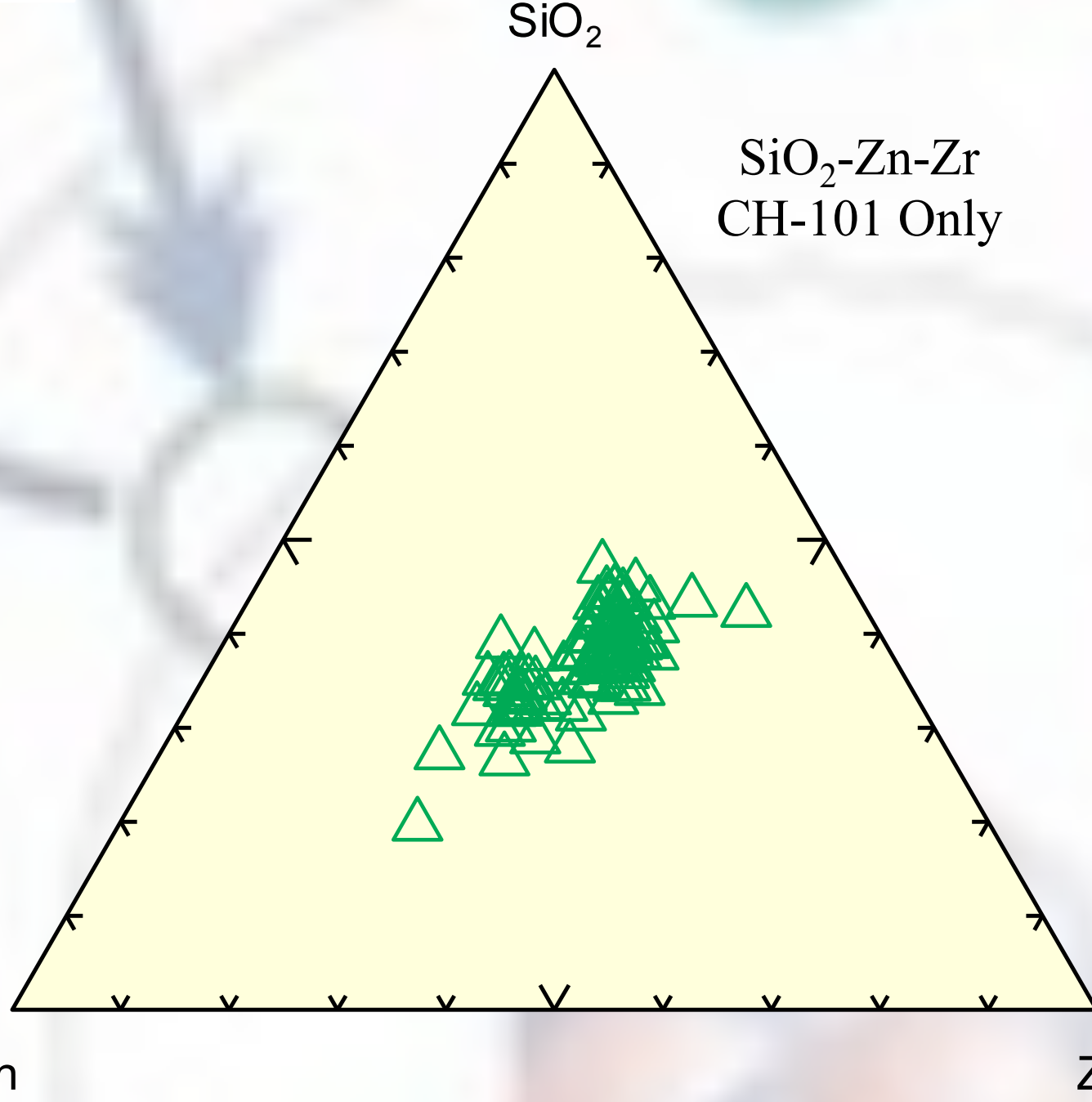
A majority of the flakes analyzed were collected from CH-101. They range in size from 2 cm to 6 cm, smaller being more common.

Results

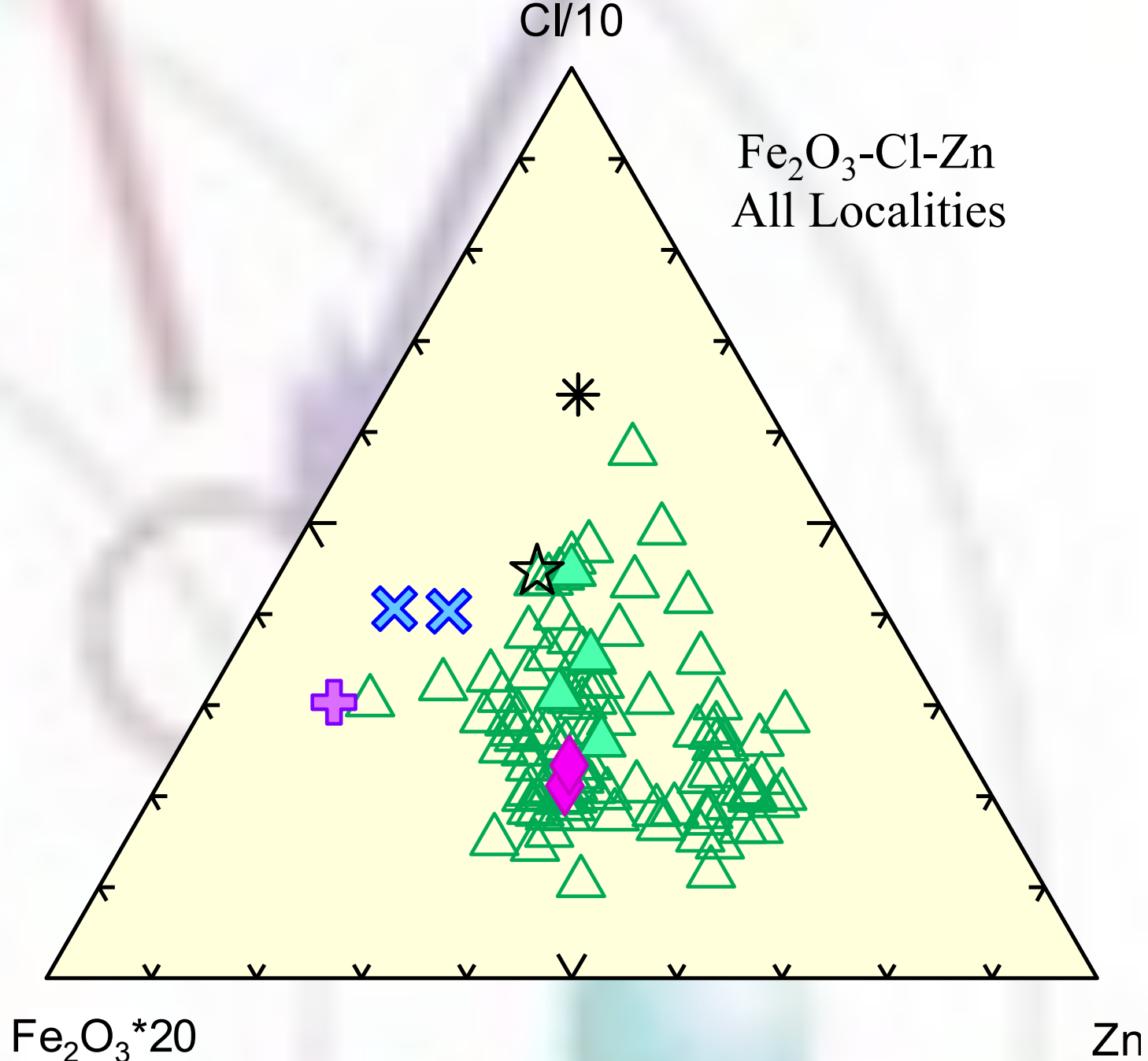
Data plotted in ternary diagrams show chemical variations between artifacts. Different compositions indicate that raw lithic materials used to produce tools were obtained from multiple sources, whereas similar compositions indicate the same origin.



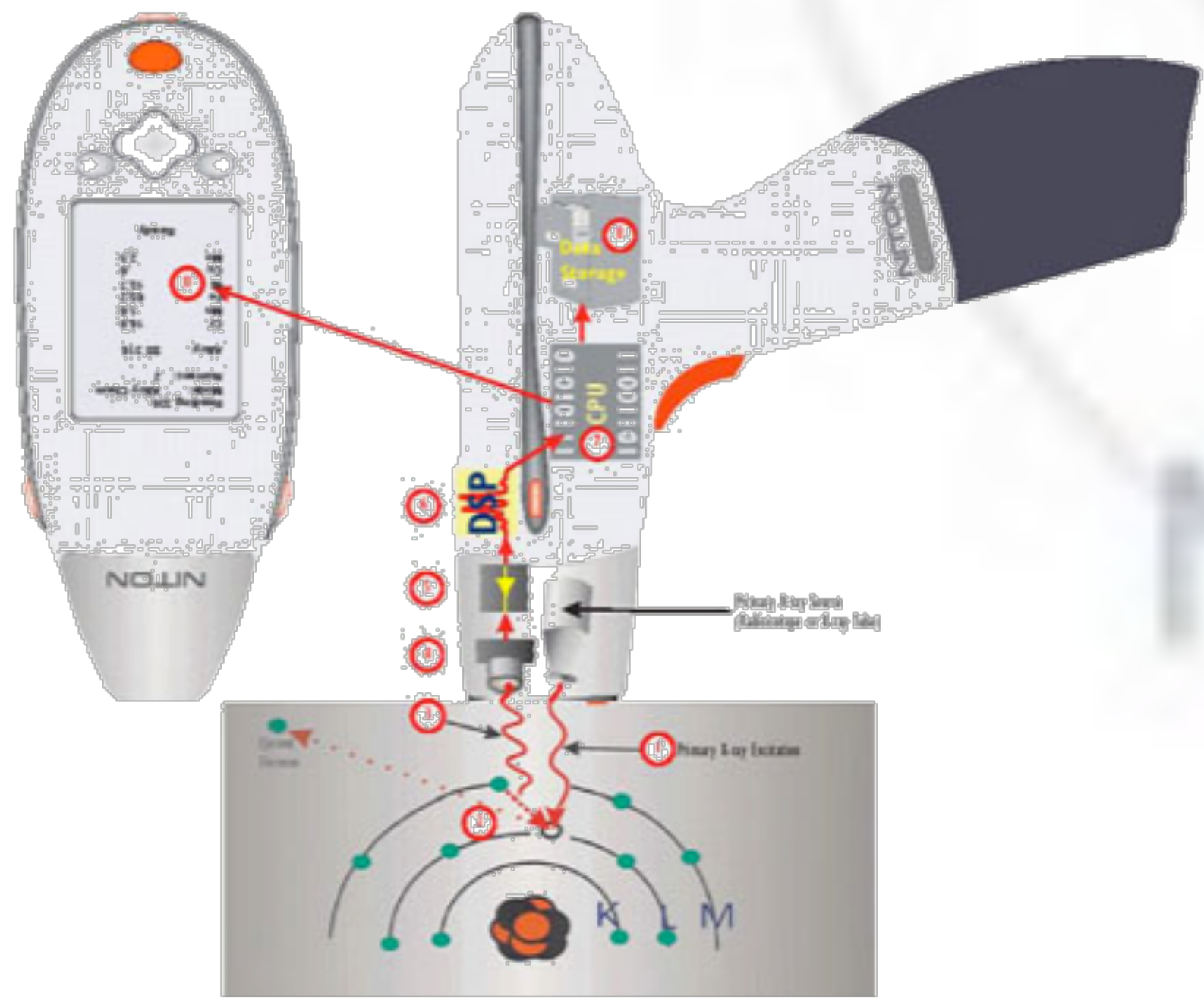
Each shape corresponds to a different location in WI.
☆ CH-117
× CH-15
△ CH-101
◇ CH-36
+ CH-60
* CH-72



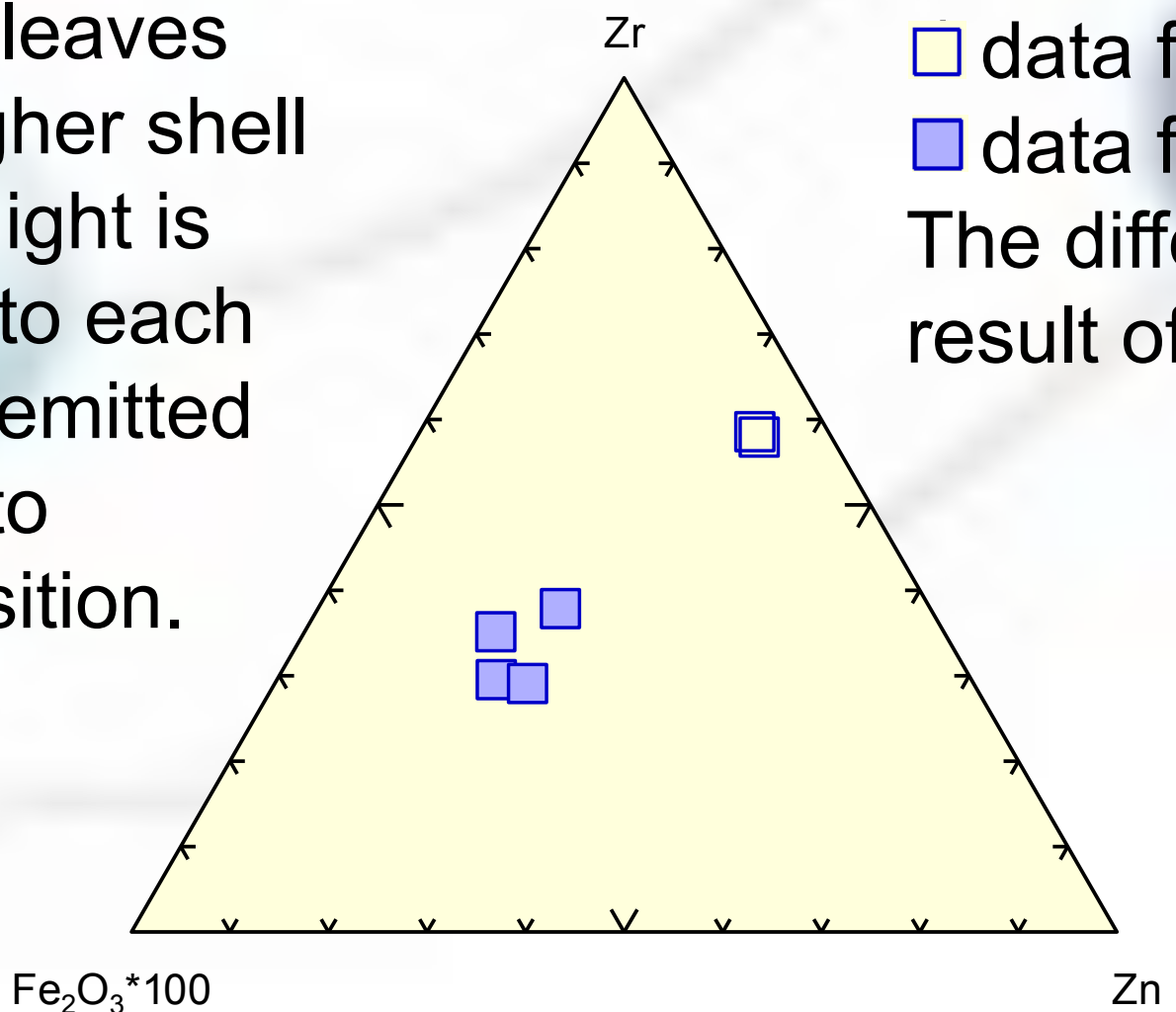
Note that there appear to be two distinct groupings forming within the 100 flakes analyzed, indicating that the material used originated from two different quarries. All of these flakes △ were gathered at CH-101.



The two groupings are slightly more spread out but still visible. As in the first diagram, artifacts discovered in different areas show distinguishable chemical characteristics.



X-rays are emitted by the Handheld XRF, when they hit the sample the energy from the X-rays excite electrons, this leaves vacancies which are filled by higher shell electrons. When this happens, light is emitted at wavelengths specific to each element. The XRF collects this emitted light and uses the wavelengths to determine the chemical composition.



This red and cream banded flake found at CH-101 was analyzed,
□ data from the cream band
■ data from the red bands
The difference in color is the result of differences of Fe_2O_3 .



Red Lithic Artifacts

The artifacts surveyed by XRF consisted of flakes (the refuse from forging tools) and tools (arrow heads, hammers, etc.) donated to UWEC. Of the artifacts, 100 were flakes and 5 were actual tools.

Importance to Archaeology

Stone tools and flakes from the manufacturing and maintenance of tools are the most common artifacts found in Wisconsin. Determining the source of the raw materials used to produce these artifacts is an important component of archaeological analysis. This analysis provides information essential to reconstructing the past: territory size, trade networks, migration patterns, and how past inhabitants used their environment. If the original sources of the artifacts analyzed can be accurately identified, XRF has the potential to contribute vital information about western Wisconsin's past.

Future Work

More red lithic artifacts will be analyzed using XRF to provide a larger sample size for comparison. Samples taken from known red lithic quarries will also be analyzed, and their chemical composition will be compared with that of the artifacts to determine origin of the stones. Further, the geochemical information from this project will be compiled into a database of lithic "fingerprints" for use by others. This technology also has the potential to be used with artifacts manufactured from other types of materials.

Acknowledgements

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