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Epistemology and Synthesis: Instrumental Neutron Activation Analysis and the Caddo Tradition

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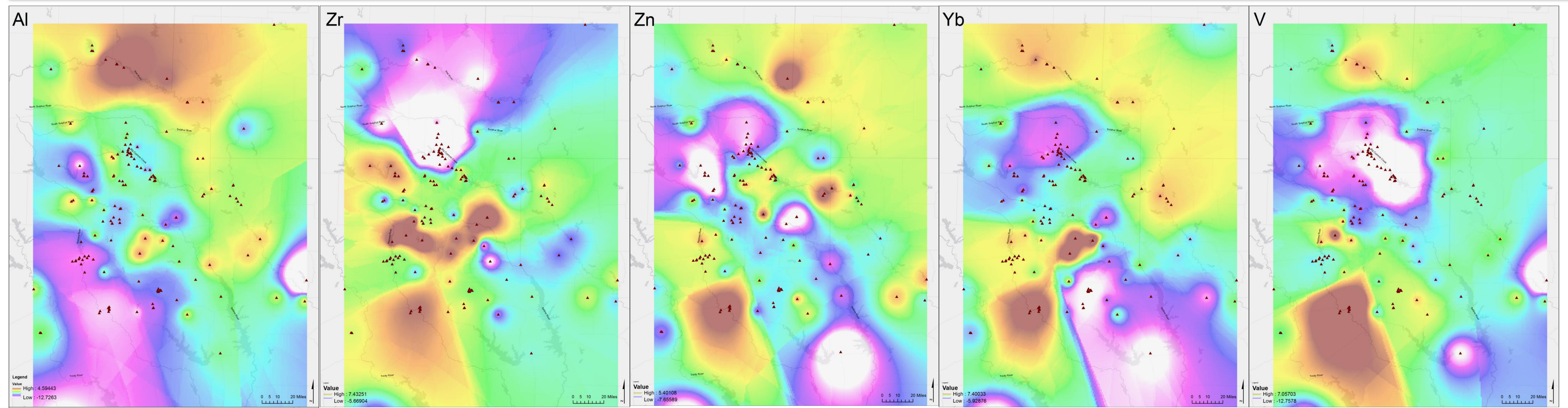
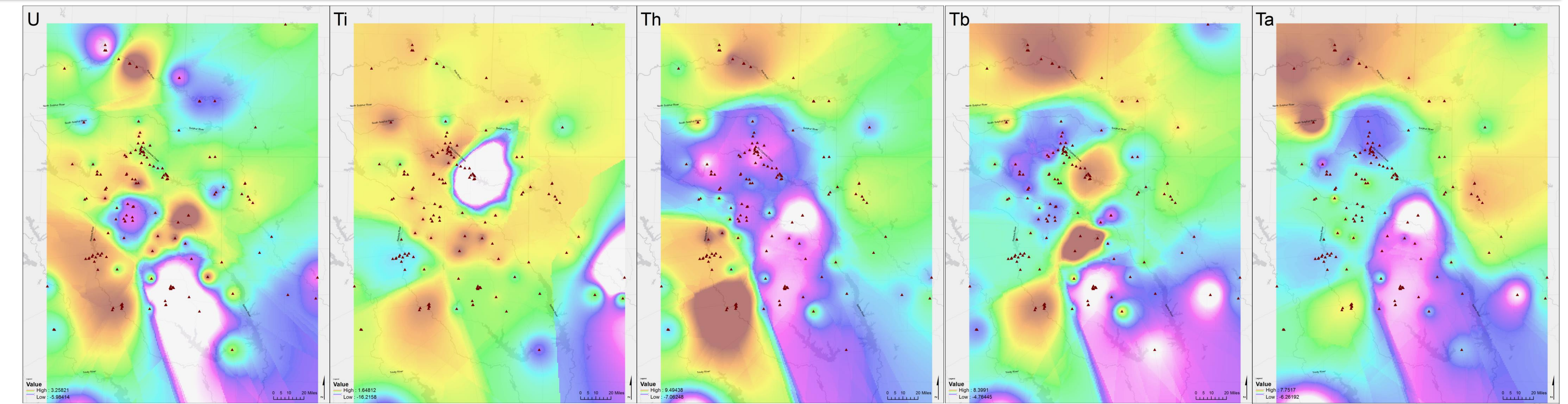
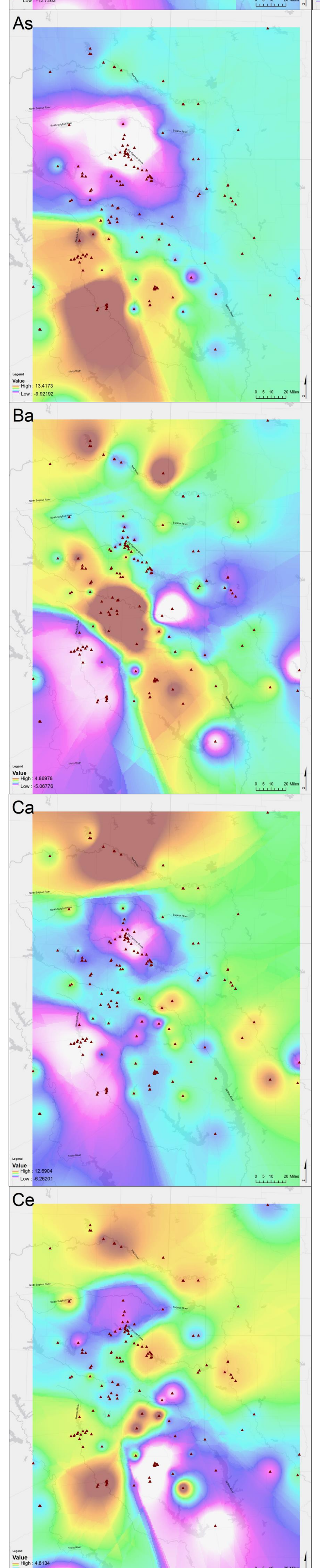




ABSTRACT

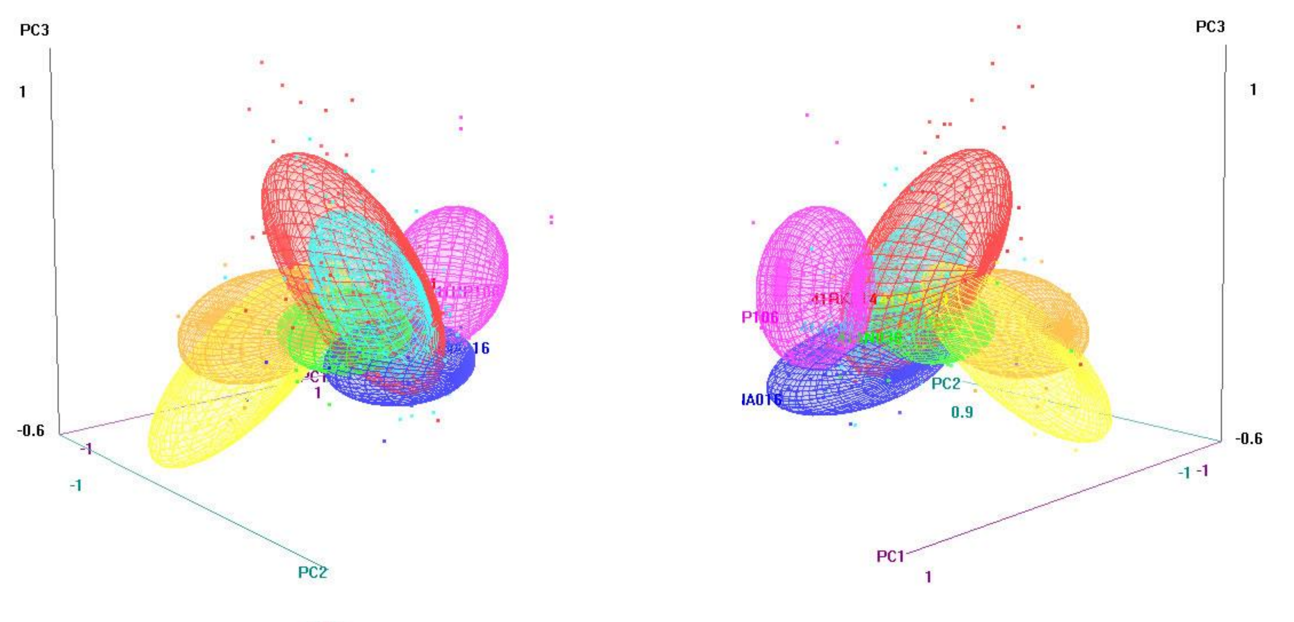
The statistical groupings illustrated below represent the current iteration of Caddo INAA compositional groups based upon the chemical composition of archaeological ceramics. For some time, a number of Caddo archaeologists have thought these results to be lacking. This poster symbolizes the first step toward a new interpretation of chemical composition groups, and the initial instance within which GIS has been employed as an analytical tool.



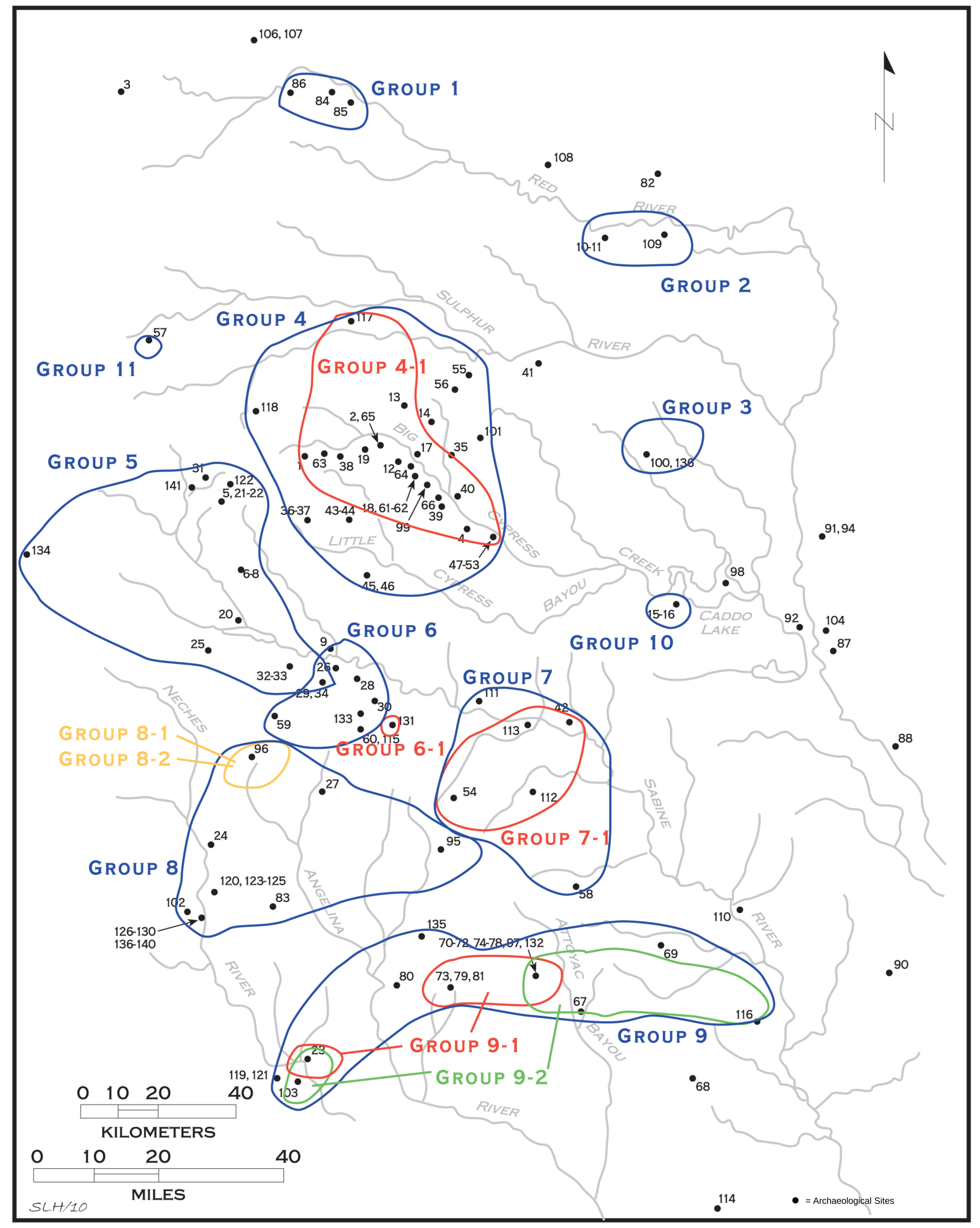
INTRODUCTION

Holding true to the processual undertone of the region, instrumental neutron activation analysis (INAA) has been employed within the context of ceramic studies focused upon the Caddo tradition since 1995 in an effort to generate probable zones of ceramic manufacture, use, and discard (Ferguson 2007, Perttula and Ferguson. 2010). This article provides (1) a general synthesis of the results of INAA endeavors in the Caddo region over the past 17 years, and (2) possible avenues for future research.

Thanks to significant assistance from several Caddo-centric archaeologists, the geochemical data from all previous Caddo INAA endeavors has been assembled, and is used as the basis for this endeavor. Those data employed in this research design include 1281 assays from 171 archaeological sites across the traditional Caddo landscape of southwest Arkansas, northeast Louisiana, east Texas, and southeast Oklahoma. Included within the current database are an additional 57 assays of Caddo ceramics recovered from 17 sites in Central Texas that fall beyond the geographic boundary of the Southern Caddo Area.



Within the context of his more recent analyses, Ferguson (2010:2) "began to question the utility of a compositional group structure that could not assign a large percentage of new samples and continued to remove previously assigned samples from the compositional groups in order to maintain statistical separation of the groups." As a whole, the Caddo region ranks within the top three with regard to the number of INAA samples that have been analyzed (only surpassed by the Valley of Mexico and the Membres region of the American Southwest), but due to the dominance of similar alluvial clays within the region it presents something of a statistical conundrum (Ferguson 2010). In their recent report of 36 samples submitted for analyses from the 41CP408 site, Ferguson and Glascock (Ferguson and Glascock 2011:6) point out that—due to statistical overlap within the current database of Caddo INAA—determining potential locations of ceramic production has become increasingly difficult.



ADDRESSING THE PROBLEM

In an attempt to better comprehend the geochemical composition of ceramic sherds across the traditional Caddo landscape, the INAA results for 1192 sherds from 171 sites are employed within this discussion. After assembling the dataset, two tables were used—one with geochemical data, one with site data—to catalog the sample. In reviewing the literature all of the shell and bone-tempered sherds were noted, but the calcium correction (see Steponaitis et al. 1996:559) was only applied to the 4% (n=47) of samples known to be shell-tempered.

The calcium correction was applied to these 47 sherds in version 2.15.2 of R, using the script

```
corrected <- apply(INAA_all[,10:42],2, function(x)1000000*x/(1000000-2.5*INAA_all$Ca))
```

after which those sherds were recombined with the bone and other-tempered sherds, and the log-10 of each element was calculated, adding a value of one to each sherd/element in the database, modifying all missing values that are now represented by a zero. Subseqently, the Getis-Ord Gi* statistic in ArcGIS 10 was employed to calculate a z-score for each log-10 value, illustrating the spatial distribution and z-score value for each element using the formula:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j}\, x_j - \bar{X}\sum_{j=1}^{n} w_{i,j}}{s\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}}$$

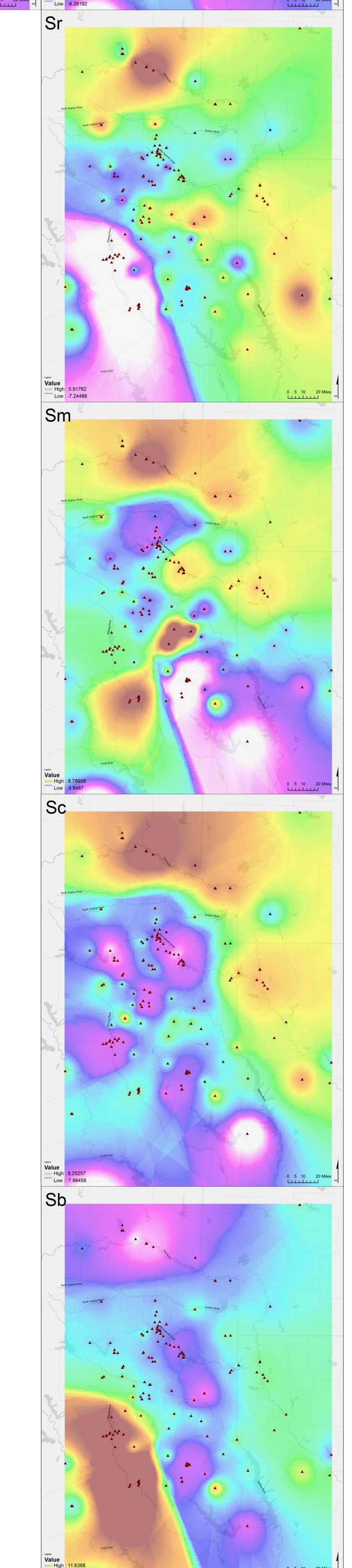
where x_j is the attribute value for feature j, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j}^{n} x_j}{n}$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2}$$

The G_i^* statistic is a z-score so no further calculations are required.

Following the calculation of z-scores for each element, these data were then used to calculate the deterministic statistic of inverse distance weighted (IDW) for each element (S). The question answered by IDW analyses is "[a]re there discrete features that are very close to each other or in the same location" (Mitchell 2005:145). The resultant geographic for chromium affirms Ferguson's (2007:15-16) assertion regarding an apparent gradient in the Sabine River drainage, an observation which might now be extended to all but the Red River drainage. This represents merely the first step toward understanding the complexity of geochemical attributes associated with Caddo ceramics, and will assist with discerning potential trade and exchange patterns across the traditional Caddo territory and abroad.



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*References available upon request