



MOUNTJOY CARBONATE RESEARCH CONFERENCE III

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The Visual Display of Quantitative Geologic Data

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Retired

Statistical graphs reveal patterns and details within large data sets; this presentation encourages their use in carbonate research and publication. Microsoft Excel is an excellent tool for compiling information from tens of thousands of data points, but Excel's default graphs are abysmal. As a result, I present for your use graph-templates formatted to be publication-ready.

Box Plots, Histograms, and Probability plots portray the shape of a data set. Kernel-density plots highlight peaks and troughs in distributions. Ternary diagrams help visualize compositional variations among rocks. X-Y Scatterplots calculate the slope and intercept of a best-fit regression line, with 95% confidence intervals for the location of the line. Figure 1 offers thumbnail examples; my presentation will offer full-size plots with explanations.

Probability plots and box plots compare porosity, permeability, and size distributions among rock types. These graphs have other research applications, particularly when dealing with hundreds to thousands of data points. For example, a histogram of carbon-isotope data from Upper Ordovician carbonates in Estonia has multiple modes, suggesting a mix of populations. Sorting the data by age demonstrates that Katian-aged samples follow a normal distribution with a mode near +1.3 ‰ PDB, while Hirnantian samples are much heavier. The blue curve is a kernel-density plot of data distribution. Violin plots based on kernel-density highlight an "excursion" to heavier carbon at worldwide localities within Upper Ordovician carbonates, implying global environmental change that happened to coincide with a global extinction event. Another example compares Uniaxial Compressive Strength among rock types; high UCS rocks will fracture under stress; note the overlap between granite and carbonate samples. A ternary plot from the Monterey Formation shows that brittle chert and dolostone contain low detrital clay.

Probability plots provide evidence of two hominin taxa in East Africa during the Pliocene. Five sets of tracks dated to 3.66 Ma belong to *Australopithecus afarensis*, while a sixth set of tracks (location A3) seemed different. Width/Length ratios of Recent and Pleistocene human tracks fit a normal distribution, and A3 tracks are more than 99.999% different from the modern or Pleistocene human populations. Pliocene *A. afarensis* tracks also pass a statistical test for normality, though the small sample size results in a broad 95% confidence interval for the best-fit line. A3 intersects the upper 95% confidence band at 98%, indicating that if an *A. afarensis* individual made track A3, that individual was at least in the upper 2% of the population width/length distribution. Either this individual was an "oddball," or from a different taxon. Springer-Nature published the study, supporting the author's request to fund more fieldwork to resolve the question.

XY scatter plots establish correlations among data sets; 95% confidence bands quantify the uncertainty of predicting Y from a knowledge of X.

This presentation encourages the use of statistical graphs in geologic research and publication. If your institution has access to commercial statistical software, you should use it; commercial

packages offer many more plot types. If not available, you can download the Excel templates presented here.

