Using the LIMS with Lithology (LILY) Database to Probe IODP Density, Porosity, and P-Wave Velocity Data

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We use the LIMS With Lithology (LILY) database compiled by Childress et al. (https://zenodo.org/records/8408297) to examine relationships between physical properties and the lithology of marine drill cores collected by the International Ocean Discovery Program (IODP) and its precursor program between 2009 and 2019. Within LILY, lithologic information such as the principal lithologic name and the major and minor lithologic modifiers, along with other metadata, have been added to each of the more than 34 million observations from the standard data available in IODP's LIMS Database, which is accessible through the LIMS Online Reports (LORE) portal (web.iodp.tamu.edu/LORE/). The ability to compare and combine descriptive lithologic information across expeditions and to integrate these descriptions with multisensor track and discrete sample measurements allows for a wealth of scientific investigation not possible under the original data structure. One of the obvious values of LILY is the ability to characterize the basic physical, chemical, and magnetic properties of different lithologies from a very large number of observations. As an example of this, we compute grain densities for all available lithologies using the Moisture and Density (MAD) density data from over 24,000 measurements. Once the grain densities are known, then the bulk densities can be used to determine porosity. This is important because besides the over 24,000 MAD bulk densities, there are 3.7 million gamma ray attenuation (GRA) bulk densities measured by the Whole Round Multi-Sensor Logger (WRMSL). Comparison of MAD and GRA bulk densities permits biases in the GRA density dataset to be corrected. These corrected GRA bulk densities are then used to compute a new high-resolution porosity dataset (https://zenodo.org/records/10001855). We further merge this large bulk density and porosity dataset with the P-wave velocity data from a P-wave Logger that is part of WRMSL, a P-wave Caliper, and P-wave Bayonets to characterize lithologic-dependent relationships between density, porosity, and P-wave velocity.