

U.S. GEOLOGICAL SURVEY PILOT STUDY RESULTS FOR PARTICLE SIZE DISTRIBUTION ANALYSES OF QUALITY ASSURANCE SAMPLES

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Abstract: The United States Geological Survey (USGS) operates laboratories for the analysis of physical characteristics of fluvial sediment. The USGS Branch of Quality Systems (BQS) initiated the Sediment Laboratory Quality Assurance (SLQA) project in August 1996 to ensure that physical sediment data produced or used by the USGS are of a known quality and provide long-term comparability and consistency. The project quantifies bias and precision for suspended sediment concentration (SSC) and particle size distribution (PSD) analyses for participating laboratories. PSD analyses currently include determination of sand (≥ 0.063 mm) and fine (< 0.063 mm) sediment portions only. USGS laboratories routinely produce PSD determinations for the fine sediment portion, in standard silt/clay size ranges (mm): < 0.002 , < 0.004 , < 0.008 , < 0.016 , < 0.031 , which are not being quality-assured by the SLQA project. Characterizing PSD aids investigators in identifying physical sediment transport mechanisms and deposition processes. Quantifying precision and bias of PSD analyses using SLQA performance evaluation samples would provide confidence limits for data interpretation.

During fall 2004, BQS conducted a pilot study using commercially-available test dust to determine its suitability for quality assurance (QA) samples intended for PSD analysis, in standard silt/clay size ranges, by SLQA project participants. The PSD for the test dust material was determined by the manufacturer using the Multisizer II Coulter Counter which measures particles individually by volume. During preparation of the test dust and water mixtures, BQS calculated the PSD for the QA samples using the manufacturer's PSD determinations. In the study, four USGS laboratories each received 3 sets of triplicate samples, with sediment mass ranging from 1,600 to 5,000 mg. The four laboratories have participated in the SLQA project since its inception and produce comparable data quality. Three of these laboratories used the pipette method and one laboratory used the SediGraph 5100 for PSD analysis. Prior to this study, PSD results for standard silt/clay size ranges produced by individual USGS laboratories have not been compared to each other.

Data submitted by the four participating laboratories were comparable. Ninety-seven percent of the analyses were within 10 percent of the target value determined by BQS during sample preparation. Results for the triplicate sample sets indicated precision was within 7 percent for each laboratory. The median values of reported percentages for particle size denominations 0.002, 0.004 and 0.031 mm were greater than the target values (positive bias) for all laboratories. Reported percentages for the 0.008 and 0.016 mm sizes were negatively biased for laboratories using the pipette method. The SediGraph method produced results that were positively biased for all particle sizes. Overall, pilot study results indicate small bias and variability among the laboratories for the test dust samples, comparable to bias and variability determined for suspended sediment concentration and fine/sand separation analyses in previous SLQA studies. The low variability and bias represented in the laboratory results indicate that BQS can formulate reproducible QA samples for laboratory analysis using the test dust. Dissolution of the material is minimal, and the manufacturer-specified PSD characteristics are accurate for calculating target properties for the SLQA project.