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Applicability Comparison of Methods for Acid Generation Assessment of Rock Samples

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Minerals including various forms of sulfur could generate AMD (Acid Mine Drainage) or ARD (Acid Rock Drainage), which can have serious effects on the ecosystem and even on human when exposed to air and/or water. To minimize the hazards by acid drainage, it is necessary to assess in advance the acid generation possibility of rocks and estimate the amount of acid generation. Because of its relatively simple and effective experiment procedure, the method of combining the results of ABA (Acid Base Accounting) and NAG (Net Acid Generation) tests have been commonly used in determining acid drainage conditions. The simplicity and effectiveness of the above method however, are derived from massive assumptions of simplified chemical reactions and this often leads to results of classifying the samples as UC (Uncertain) which would then require additional experimental or field data to reclassify them properly. This paper therefore, attempts to find the reasons that cause samples to be classified as UC and suggest new series of experiments where samples can be reclassified appropriately. Study precedents on evaluating potential acid generation and neutralization capacity were reviewed and as a result three individual experiments were selected in the light of applicability and compatibility of minimizing unnecessary influence among other experiments. The proposed experiments include sulfur speciation, ABCC (Acid Buffering Characteristic Curve), and Modified NAG which are all improved versions of existing experiments of Total S, ANC (Acid Neutralizing Capacity), and NAG respectively. To assure the applicability of the experiments, 36 samples from 19 sites with diverse geologies, field properties, and weathering conditions were collected. The samples were then subject to existing experiments and as a result, 14 samples which either were classified as UC or could be used as a comparison group had been selected. Afterwards, the selected samples were used to conduct the suggested new experiment. In the sulfur speciation test, two samples showed acidities that were considerably different than those of Total S test due to existence of non acid producing sulfate minerals. Most of the ABCC values showed significantly different results from ANC and this difference was the most major factor that distinguished the proposed methods from the existing ones. The main reason that differentiated ABCC from ANC was the difference in dissolved substances. While carbonate was the primary substance that was dissolved in ABCC test, in ANC, silica minerals (such as anorthite) dissolves, which hardly show its neutralizing capacity in nature, were also found in addition to carbonate. Modified NAG and existing NAG test also showed different results in two coal mine originated samples which contained high carbon contents (approximately 20%) showing similar tendencies to previous studies on effect of organic acid generated from organic matters on NAG values. After comparing NAPP-NAG graph results from each series of experiments, it showed that the correlation coefficient increased from 0.8585 (existing) to 0.9712 (proposed). Also, results showed that UC classified samples were mostly reclassified to PAF(Potentially Acid Forming), confirming that the proposed methods can suggest a more accurate evaluation of acid generation.