
Introduction: Resource assessments provide governments and institutional leaders a framework for making decisions under conditions of uncertainty by supplying information about resources in terms of potential occurrence, distribution, type, quality, amount, value, and certainty in assessment results [1]. Mineral resource assessments include a variety of approaches, from qualitative techniques that identify favorable areas for the occurrences of resources to quantitative techniques that calculate probabilistic estimates of in-place resources. Quantitative resource assessments are expressed in the form of maps with prospective areas rated as high-medium-low, or on a unitless numerical scale for the predicted occurrence of a resource. Qualitative resource assessments provide a solution for regions that have insufficient data to conduct a fully quantitative assessment [2]. Quantitative assessments, such as the Three-Part Method, incorporate information that includes 1) permissive tracts, 2) resource grade and tonnage (quality and quantity) models, and 3) estimates of the number of undiscovered deposits (Figure 1) [1]. As a compromise between quantitative and qualitative resource assessment approaches, a semi-quantitative assessment can incorporate quantitative statistical data where appropriate as well as qualitative input such as expert observations and opinions.

Depending on the amount and type of data available, the nature of the deposit, and accessibility to analogue data, the Three Part Method may be applicable to assess resources on cosmic bodies. The Three Part Method is a USGS developed, well-established, quantitative method of estimating undiscovered resources. The Three Part Method has been successfully applied at the local and global scale to numerous commodities (see minerals.usgs.gov/science/assessments.html). The Three Part Method leverages a Mineral Deposit Model (MDM), which is a collection of information gathered in and around known deposits, and discriminates 1) possible mineralized environments from those that are barren, 2) types of known deposits, and 3) mineral deposits from occurrences. MDMs are composed of the essential attributes that describe a deposit type rather than a single deposit and include information such as mineralogy, alteration, geochemical, and geophysical anomalies [1]. The MDM directly informs delineation of Part 1, permissive tracts (mineral resource maps that delineate areas of favorable features/characteristics that are associated with the occurrence of a resource) and Part 3, estimation of the number of undiscovered deposits (Figure 1) [3].

Grade and Tonnage models (Part 2) consist of frequency distributions of tonnage (mineralized-bearing material) and average grade (quantity of mineral contained within a unit weight of mineral-bearing material) for analogue deposits (i.e., deposits that have been identified as belonging to the same MDM). They are populated from data collected from well explored areas and are used as one input into the Three Part Method [1].