Faced with an ever-increasing diversity of demand for the use of public lands, managers and planners are turning more often to a multiple-use approach to meet those demands. This approach requires the uses to be mutually compatible and to utilize the more valuable attributes or resource values of the land. Therefore, it is imperative that planners be provided with all available information on attribute and resource values in a timely fashion and in a format that facilitates a comparative evaluation.

The Kootenai National Forest administration enlisted the U.S. Geological Survey and U.S. Bureau of Mines to perform a quantitative assessment of future copper/silver production potential within the forest from sediment-hosted copper deposits in the Revett Formation that are similar to those being mined at the Troy Mine near Spar Lake. The U.S. Geological Survey employed a quantitative assessment technique that compared the favorable host terrane in the Kootenai area with worldwide examples of known sediment-hosted copper deposits. The assessment produced probabilistic estimates of the number of undiscovered deposits that may be present in the area and of the copper and silver endowment that might be contained in them.

Results of the assessment suggest that the copper/silver deposit potential is highest in the southwestern one-third of the forest. In this area there is an estimated 50 percent probability of at least 50 additional deposits occurring mostly within approximately 260,000 acres where the Revett Formation is thought to be present in the subsurface at depths of less than 1,500 meters. A Monte Carlo type simulation using data on the grade and tonnage characteristics of other known silver-rich, sediment-hosted copper deposits predicts a 50 percent probability that these undiscovered deposits will contain at least 19 million tonnes of copper and 100,000 tonnes of silver. Combined with endowments estimated for identified, but not thoroughly explored deposits, and deposits that might also occur in the remaining area of the forest, the endowment potential increases to 23 million tonnes of copper and 190,000 tonnes of silver.

Key words:
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Introduction

Passage of legislation designed to deal with public land use has brought management and utilization of public lands in the United States under close scrutiny within the past 30 years. During this period a wide range of special interest groups have worked to educate the public about the diversity of uses these lands serve beyond their traditional role—that of a source of raw materials to support the nation's economy. In light of this heightened state of awareness and the broadened spectrum of land uses being required, land management agencies are responding with land-use plans formulated around the principles of multiple use, as opposed to single-purpose use. The concept of multiple use favors mixed use where uses are compatible, favors use of the land's more valuable attributes and resources, and fulfills currently perceived national needs. It also encourages the preservation of access to other highly valued resources or attributes that may not be needed now but may be preferentially developed in the future as national priorities dictate.

To maintain balance in the implementation of a multiple-use policy, planners must have access to up-to-date and comprehensive assessments of all known and undiscovered resources and other attribute values. It is equally important, because of the wide diversity of values being evaluated, that the information be supplied in a form that facilitates the analytical process. In the case of surface attributes and resources that are readily observable and measurable, the assessment methods generally produce quantitative results that lend themselves to conversion into dollar-value equivalents. However, suburface resources, which are not readily observable or even known with certainty, are more difficult to quantify and have rarely been assessed in terms of a dollar equivalent. Mineral values are such an example. Understandably, when a resource is not expressed in monetary terms, it may be overlooked or severely discounted in the process of reaching a land-use decision simply because it lacks a means of ready comparison.

The U.S. Geological Survey has traditionally been responsible for acquiring mineral resource information and providing qualitative evaluations based on that data to land management agencies. By the early 1980's, the Survey's regional mineral resource assessment methods were capable of identifying lands as geologically favorable for hosting mineral deposits and of specifying the relative degree of that favorability or potential in nominal terms, that is, high, moderate, or low (Shawc, 1981). In most cases, an assessment was preceded by a lengthy period of investigation using classical evaluation techniques, in which additional geologic mapping was conducted, stream sediment and rock samples were collected for chemical analysis, and geophysical data were collected or reprocessed before the mineral resources could be subjectively estimated. Now, however, the expense, the lack of estimates expressed in monetary terms, and the often lengthy time required to conduct such assessments preclude use of these methods in responding to the urgent requests for resource assessments by land-use agencies. Practical necessity argues for a change to an assessment technique that can deliver estimates of undiscovered mineral resources in a form that is easily convertible to monetary equivalents rapidly enough to meet the needs of planners.

The form of assessment adopted by the Survey was first described by Singer (1975). Early applications are discussed by Singer and Ovenshine (1979). This form of assessment uses probabilistic estimates of deposit occurrence in place of the nominal high-, moderate-, and low-potential assessment terminology previously used. These probabilistic estimates are combined with deposit grade and tonnage distribution models in a Monte Carlo simulation analysis to produce hypothetical estimates of undiscovered resource endowment. Several examples of this application have been published (Drew and others, 1986, and Reed and others, 1989). Among the advantages of the method are (1) it utilizes geological data routinely collected by geologists; (2) it is tolerant of variations in the quality and quantity of available data; and (3) it can be performed relatively quickly because in many cases available data can be used. In the early 1980's, the U.S. Geological Survey, in cooperation with the U.S. Bureau of Mines, extended this regional mineral assessment approach to make it more responsive to the needs of land-use planners. The Survey assumed responsibility for producing estimates of the amount of minerals or contained metal that might be present in concealed deposits in a given permissive terrane. The Bureau of Mines assumed the further responsibility of developing methods of estimating the overall economic impacts associated with the recovery of those mineral or metal endowments based on differing scenarios. This article and the one to follow demonstrate the application of the quantitative assessment procedure as developed by the Survey and Bureau of Mines. This article covers estimation of the metal endowment of undiscovered deposits, and the second will analyze the economic consequences of mining the recoverable portion of the endowment in the Kootenai National Forest.

The Kootenai National Forest includes approximately 2.3 million acres of public lands in extreme northwestern Montana and small portions of Idaho. It is an area of demonstrated value for timber, wildlife habitat, and scenic views. Over 94,000 acres are protected in the Cabinet Mountains Wilderness Area and additional areas have