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Overcoming survival bias in targeting mineral deposits of the future: Towards null and negative tests of the exploration search space, accounting for lack of visibility

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ABSTRACT

Broad consensus exists amongst mineral explorers that most outcropping mineral deposits have been found. The next generation of discoveries will rely on our ability to recognize the subtle or cryptic signals of deep-seated deposits. Exploration targeting under such conditions requires greater knowledge of the processes that formed the targeted mineral deposit types and new or improved exploration methods designed to effectively test for buried mineralization. Survival bias is a form of selection bias that is defined as the logical error resulting from neglecting data or information because of their "lack of visibility". In this study, "lack of visibility" refers to situations where (i) mineral explorers ignore or overlook particular terrain because it lacks or contains only weak signals of a mineralizing system, and (ii) such areas are excluded from further exploration as the existing data or information neither confirm nor support the targeting model. Therefore, it is critical to more comprehensively analyze a search space to more confidentially determine whether a terrain without the desired targeting signals satisfies the criteria of a null or negative test. The idea for this study is based on the notion that if a buried mineral deposit was present in an overlooked terrain it would nevertheless comprise distinctive geological features and targeting signals to guide the explorer, although, more likely than not, these signals would be very weak. Here we used a porphyry copper (Cu) district in Iran to explain and illustrate the adaptation of the survival bias concept. More specifically, in this study we tested the usefulness of a recently proposed targeting criterion, namely sites of potential focused fluid flux, as an input to mineral prospectivity analysis and exploration targeting. The findings of our study have implications for the future development of regional- to global-scale exploration information systems (EIS), designed to improve the performance of mineral exploration targeting.

1. Introduction

Data analysis methods for exploration targeting of mineral deposits have been progressively developed mainly by the analysis of geospatial data (e.g., Carranza, 2008, 2017; Carranza and Sadeghi, 2010; McCuaig and Hronsky, 2000, 2014; Yousefi et al., 2021; Yousefi et al., 2024).

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