Interpretation on geochemical data based on theories of the iso-metric logratio transformation and mixture distributions

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How to interpret logratio tranformation and fit the mixture distributions of geochemical data is a challenge for analyzing compositional data. It is proposed in this contribution that the chronological order of different geological processes characterized by some certain elements can be used to construct interpretable the iso-metric logratio transformation (ILR). This concept and the expectation-maximization (EM) algorithm modified by a minimum message length criterion (MML) were applied to capture information carried by the stream sediment data in Duolong mineral district, Northern Tibet, China. The mafic intrusions characterized by high concentrations of Cr and Ni are emplaced earlier than the Cu-Au ore-forming processes in Duolong. The competition of those two geological processes is characterized by the iso-metric logratio transformation of Cu (or Au) over Cr (or Ni). The transformed Cu and Au follow a tri-normal distribution, the high-average subpopulation of which is the fingerprint left by the Cu-Au ore-forming processes and the low-average one reflects the activities related to mafic intrusions. The medium-average subpopulation is dominated by later geological processes in Duolong. The iso-metric logratio transformation captures more information than the log-transformation. The high-average subpopulation is the anomaly left by the Cu-Au mineralization and is used to predict two areas having a prospecting potential for copper and gold resources in Duolong.