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Correlation between Mo mineralization and faults using geostatistical and fractal modeling in porphyry deposits of Kerman Magmatic Belt, SE Iran

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ABSTRACT

Kerman Magmatic Belt (KMB) is located in the southern part of Urumieh-Dokhtar Magmatic Belt (UDMB), SE Iran. There are many Cu-Mo porphyry deposits which may have correlation with existing faults. The aim of this study is determination of correlation between Mo mineralization in the porphyry deposits of the KMB and faults based on fractal and geostatistical modeling. Fault density (FD) was calculated and classified by Concentration-Area (C-A) fractal model. Moreover, the Mo values in the porphyry deposits were classified by Concentration-Number (C-N) fractal model. However, the variograms and anisotropic ellipsoids for Mo, Cu and FD show that there is a proper relationship between Mo mineralization and FD trends. Consequently, the correlation between Mo mineralization and faults was calculated by logratio matrix. Based on the results derived via the fractal and geostatistical modeling, the Mo mineralization in Cu-Mo porphyry deposit have good correlation with faults in the KMB especially in the central part of the region including Sarcheshmeh mine and Nowchun deposit. Areas with extremely FD may be prospects for exploration of new porphyry deposits.

1. Introduction

Molybdenum is a strategic metal for high-tech industries especially for alloys with high melting point. Porphyry Cu-Mo deposits are the main resources for copper and molybdenum production in the world which are controlled by faults in sub-volcanic felsic rocks (Richards, 2003; Berger et al., 2008; Pirajno, 2009; Sillitoe, 2010; Aghazadeh et al., 2015; Mirzaie et al., 2015). Porphyry deposits provide about 50% of molybdenum production of world including porphyry Mo Climax-type and Cu-Mo porphyry deposits (Ludington and Plumlee, 2009; Williamson et al., 2016). The porphyry deposits are formed during magmatic activity related to subduction and post-subduction tectonic settings (Pirajno, 2009). On the other hand, Porphyry Cu-Mo deposits are controlled by structures especially faults (Richards, 2003; Zarasvandi et al., 2005; Shafiei et al., 2009; Shahabpour, 2010; Safari et al., 2015).

Magmatic and hydrothermal ore deposits usually have a spatial relationship between mineralization and crustal structures especially faults (Sillitoe, 1997, 2010; Chernicoff et al., 2002; Groves and Bierlein, 2007; Berger et al., 2008; Mohebi et al., 2015; Safari et al., 2015; Bierlein et al., 2016). The spatial correlation for different types of magmatic and hydrothermal ore deposits with structural features are indicated by emplacement of mineralization because fractures play a significant role in providing pathways for ore forming fluids (Titley, 1982; Sawkins, 1990; Richards, 2003; Niemeyer and Munizaga, 2008; Pirajno, 2009; Laznicka, 2010; Safari et al., 2015).

The Urumieh–Dokhtar magmatic belt (UDMB) as a part of Alpine–Himalayan Tethyan orogenic belt is one of the main Cu-Mo metallogenic belts in the world which is extended from NW to SE Iran (Fig. 1; Alavi, 1994; Shafiei et al., 2009; Dargahi et al., 2010; Richards, 2015). It is a part of the collisional Alpine–Himalayan orogenic belt which is extended from the Western Europe to western China (Richards, 2014; Aghazadeh et al., 2015). There are many Cu, Cu-Mo and Cu-Au porphyry deposits in world class such as Sarcheshmeh (Iran: Waterman and Hamilton, 1975; Shahabpour and Kramers, 1987; Boomeri et al., 2009; Richards, 2014; Aghazadeh et al., 2015), Sungun (Iran: Hezarkhani and Williams-Jones, 1998; Calagari and Hosseinzadeh, 2006), Meiduk (Iran: McInnes et al., 2003; Taghipour et al., 2008), Reko Diq (Pakistan: Richards et al., 2012), Saindak (Pakistan: Richards et al., 2012), Moldova Nouă (Romania: Singer et al., 2005; Richards, 2015), Duolong (China: Li et al., 2013) and Çöpler (Turkey: Imer et al., 2013; Kuşcu et al., 2013).

Most important part of the UDMB is Kerman Magmatic Belt (KMB) which is located in SE Iran, as depicted in Fig. 2 (Hassanzadeh, 1993;

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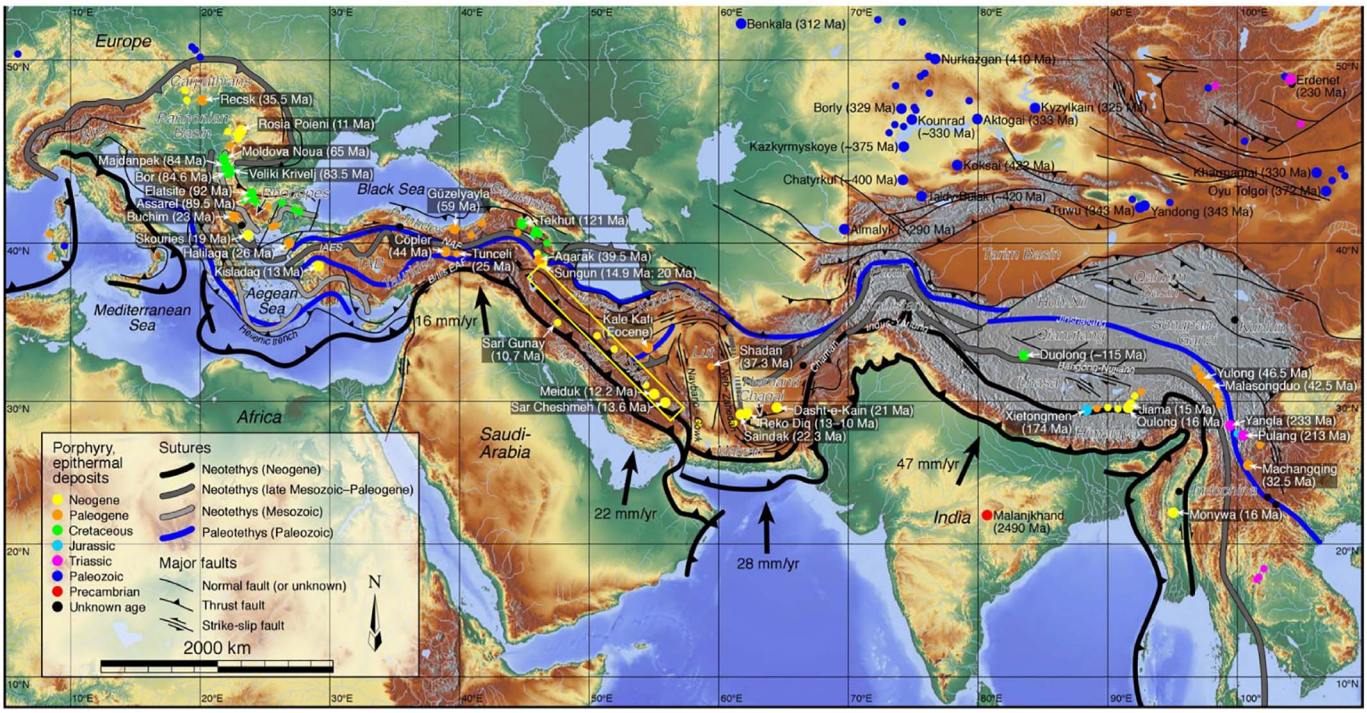

Fig. 1. The Alpine–Himalayan Tethyan orogenic belt with Cu-Mo and Cu-Au porphyry deposits (Richards, 2015; UDMA = Urumieh–Dokhtar magmatic arc which is highlighted by a yellow rectangle). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

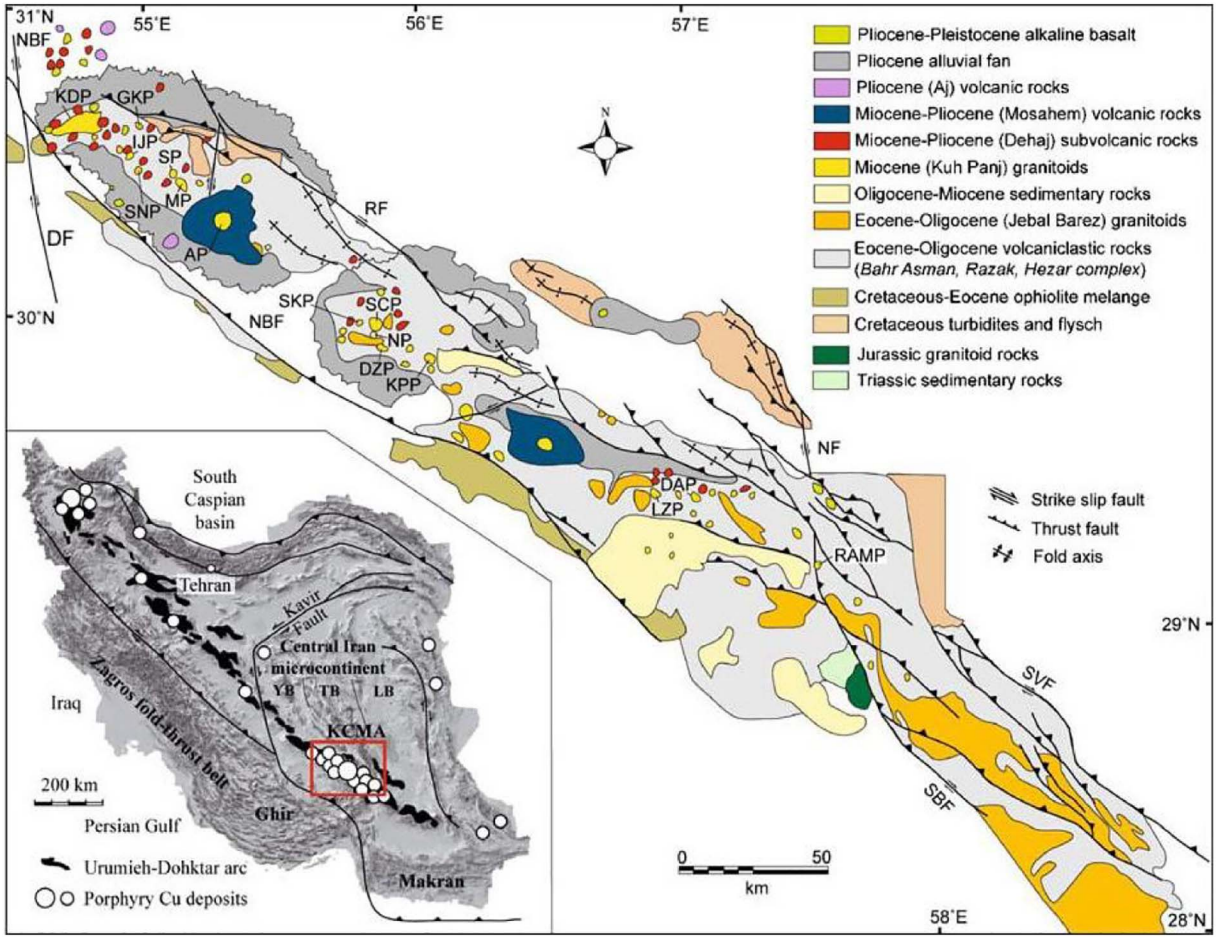

Fig. 2. Geological map for KMB and its situation in the UDMB (Shafiei et al., 2009).