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Outlining of high quality coking coal by concentration–volume fractal model and turning bands simulation in East-Parvadeh coal deposit, Central Iran

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ABSTRACT

This study aims at identifying the proper parts of C_1 and B_2 coking coal seams in the North block of East-Parvadeh coal deposit (Central Iran) using the concentration–volume (C–V) fractal modeling according to sulfur and ash values which were calculated by turning bands conditional simulation. The C–V log–log plots were generated based on results of 100 realizations derived via turning bands simulation which show seven different geochemical populations for both sulfur and ash data in B_2 seam which has a relatively good quality for coking coal with sulfur and ash values lower than 1.548% and 6.39% respectively. Additionally, C–V log–log plots indicate that there are seven and six for sulfur and ash geochemical populations in C_1 seam containing a proper coal quality with respect to sulfur and ash values less than 1.41% and 6.92% respectively. High quality populations are located in the northern and western parts of the studied area which correlated with USGS standard. The logratio matrix was used for the correlation between results obtained by the C–V fractal modeling and geological particulars consisting of pyritic veins and ash coals. Based on the logratio matrix for sulfur values higher than 3.55% and 3.39% for C_1 and B_2, respectively, low quality parts of the seams have good correlation with pyritic veins in the eastern and central parts of the area. Moreover, there are high values of overall accuracy (OA) for correlation between parts of the seams with high values of ash which are 47.86% and 39.81% for C_1 and B_2, respectively, and ash coals obtained by geological data.

1. Introduction

Recognition of coking coal parts in the bituminous coal seams is necessary for mine planning and equipment selection used for mining these seams. Ash and sulfur values are important for determination of proper coal quality for coke production regarding environmental control of coal mining (Younger, 2004). Conventional methods for modeling of various parts of coking coal are based on petrographical, physical, technological and geochemical studies especially measuring of sulfur and ash variations in the coal seams considering Russian standards and USGS system (Ahangaran et al., 2011; Brownfield et al., 2001; Wood and Kehn, 1976). The classifications based on all physical, mechanical, chemical, and technological characteristics of organic fraction of coal have been utilized in Iran since 1960s.

Geostatistical simulation has been widely used in geology and mining engineering to assess the uncertainty at un-sampled locations and to develop model the continuous variables (Emery and Lantuéjoul, 2006). Conditional simulation is designed initially to overcome the smoothing effect of kriging estimator especially when mapping sharp or extreme spatial discontinuities is looked for (Deutsch and Journel, 1998; Leuangthong et al., 2004; Soltani et al., 2014).

The simulation algorithms take into account both the spatial variation of actual data at sampled locations and the variation of estimates at un-sampled locations which means that simulation reproduces the sample statistics (histogram and semi-variogram model) and honors sample data at their original locations. Therefore, a simulation map represents the spatial distribution of the particular more realistic than a kriged map (Asghari and Madani Esfahani, 2013; Soltani et al., 2014). The geostatistical simulation is an alternative to the

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conventional approaches of estimation which is independent of over and under estimation. This benefit is an important issue in order to apply for the fractal model and could reproduce better results.

Fractal/multifractal modeling, established by Mandelbrot (1983) has been widely used in geosciences specifically for interpretation of geochemical data spatial distribution and delineation of mineralized zones from barren host rocks since 1980s (Afzal et al., 2011, 2013; Agterberg

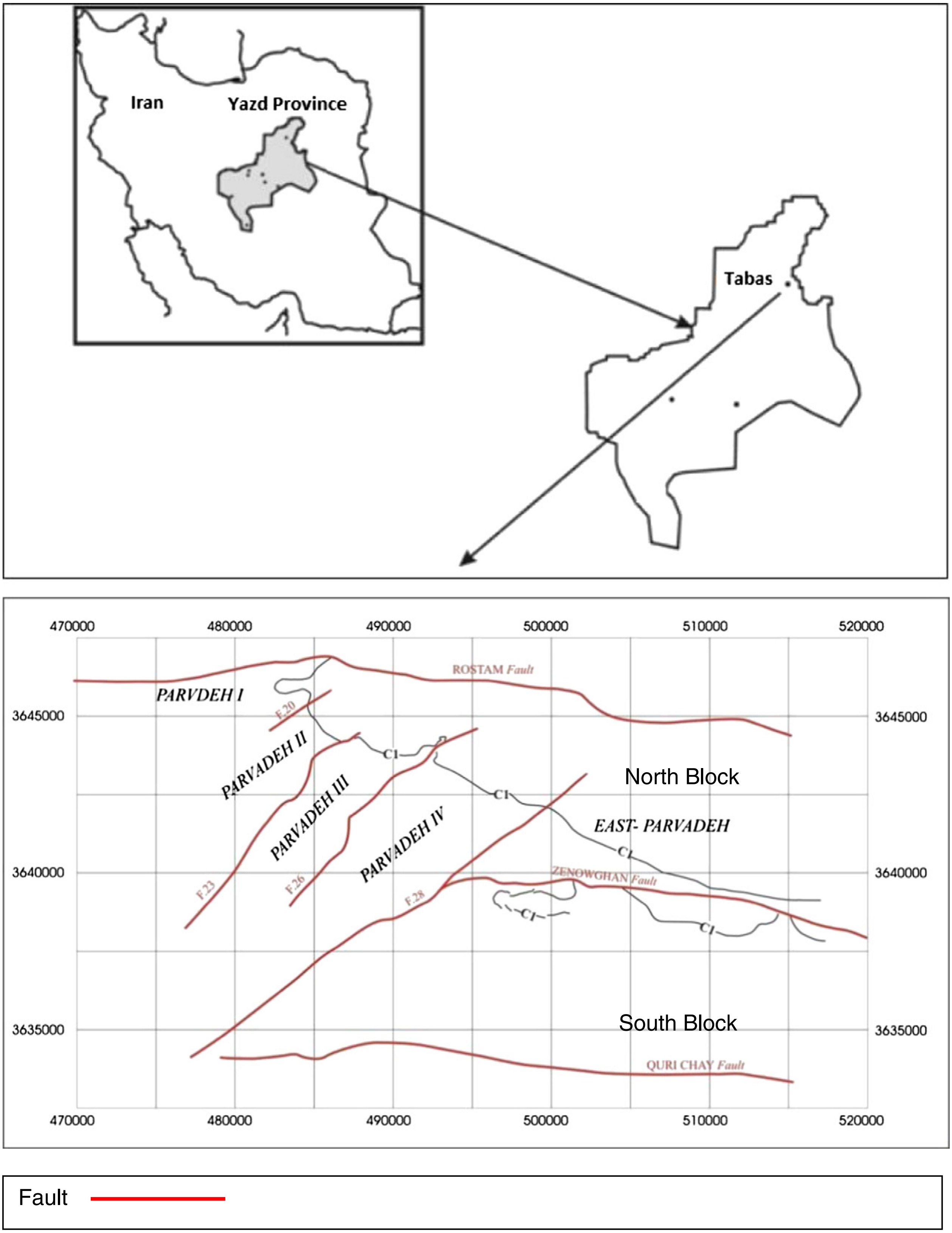

Fig 1. Location of Parvadeh deposits and East-Parvadeh blocks in the Iran and Tabas coalfield (Ahangaran et al., 2011).