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Distinguishing Different Phases for Cassiterite by Fractal Method in Gejiu,Yunnan, China

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Abstract: Distinguishing between mineral phases in rock samples is an important task in mineral deposit research and subsequent mineral resources prediction and assessment. In this paper fractal modeling is demonstrated to be an effective tool to achieve these purposes rapidly. The Gejiu Sn district in southwestern China was chosen as a study area for characterization of as well as spatial distribution of different phases of cassiterite. Vector patterns used for this study were extracted from digital photomicrographics and were analyzed with aid of MapGIS. Perimeter-area fractal dimension, cumulative number-area exponent and shape index were determined in order to quantify geometrical irregularity, and to characterize the spatial cassiterite distribution. Special attention was paid to the application and verification of the perimeter-area model, which clearly shows that there are two different types of cassiterites (Types I and II) with area-perimeter exponents (D_{APs}) of 1.34 and 1.02, respectively. This difference shows a decrease in stratification and flattening of cassiterite grains of Type II. The corresponding box-counting fractal dimensions (D_As) are 0.76 (Type I) and 0.6 (II). Fractal dimension (D_P) of the perimeter of cassiterite grains decreases from 0.51 (I) to 0.31 (II) indicating an increase in regularity. The number-area exponent increases from 0.88 (I) to 1.15 (II) implying relatively many small grains of Type II. Additionally, the mean shape indexes of 0.54 (I) and 0.64 (II), indicate that shape of cassiterite

grains of Type II is more regular than that of cassiterite of Type I. The cumulative number-shape index shows two separate straight-line segments. The first segment of smaller value of Shape index may represent anomalies due to weathering or other superimposed processes; whereas the other segment of larger value of Shape index may represent background shape realized during the process of natural crystallization. By combining the perimeter-area model with cumulative number-area plot and shape index, the two phases of cassiterite can be distinguished and characterized. One type has fewer grains of larger size, and the other has more grains of smaller size. This difference can be explained by assuming that the larger cassiterite grains formed earlier under high temperature conditions. Because of their greater surface area, the larger cassiterites underwent long time and more intensive weathering, so that their shapes became more irregular whereas the younger and more abundant small-size cassiterites retained their regular shapes.

Key Words: perimeter-area model; number-size model; number-area model; shape index; cassiterite;Gejiu