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Reflectance of dispersed vitrinite in shales hosting Pb–Zn–Cu ore deposits in western Cuba: comparison with clay crystallinity

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Abstract

The Pinar del Rio district of western Cuba contains several examples of stratiform Pb–Zn mineralization underlain by stockwork Cu mineralization. Similar deposits in Canada and Australia have been variously interpreted as products of seafloor hydrothermal systems or of much later hydrothermal activity associated with peak metamorphism during deep burial. The Cuban deposits are Jurassic in age and are less overprinted by later tectonic events than other deposits of this type, so they offer a useful opportunity to resolve these controversies.

Vitrinite reflectance and illite and chlorite crystallinity were studied from cores and mine exposures from several localities in western Cuba. Dispersed vitrinite in host shales shows a sharp increase in thermal maturity over three distinct stages from host-rock to stratiform mineralization to stock-work mineralization. Based on vitrinite data from modern hydrothermal systems, the paleotemperatures are 175, 250, and 300 °C. The clay mineral results also show a step-wise increase in the crystallinity of illite and chlorite. In addition, there is an increasing dominance of chlorite over illite. When compared to burial diagenetic trends, chlorite crystallinity in the Cuban samples matches values expected from R_r, whereas illite tends to yield lower-than-expected crystallinities. The clay results indicate that chlorite is an ore-stage mineral that equilibrated at the same temperature/pressure conditions as the vitrinite, whereas the illite is largely detrital and only incompletely recrystallized in the relatively short times available. These results are best explained as reflecting relatively low amounts of heating of shales in the country rock by burial diagenesis, progressing to intermediate heating by exhalative seafloor hydrothermal fluids in the stratiform portion of the deposits, and finally to still higher temperatures in the sub-seafloor stockwork portion.

Keywords: Vitrinite reflectance; Illite crystallinity; Chlorite crystallinity; Cuba; Black shales

1. Introduction

Jurassic rocks of the Pinar del Rio province of western Cuba are host to a number of ore deposits and occurrences of Cu–Pb–Zn–Ba mineralization (Valdes-Nodarse, 1998). Commercial operations have been carried out in two localities: Matahambre and Castellanos (Fig. 1). The first is a copper stockwork orebody with a subeconomic stratiform Pb–Zn–Ba cap, whereas the situation is reversed for the second, which has a minable Pb–Zn–Ba stratiform orebody underlain by a copper stockwork that is not being mined (Fig. 2). The working model being used in

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