



Figure 5.14. Kanawha Black Flint Shale (Sample KBF-WV). The representative EDS spectra show that the biotite is iron-rich, with minor amounts of titanium and magnesium.

Brush Creek Shale (Sample BCS3-PA). The Brush Creek shale is an ADTI reference standard selected as a primary rock sample for weathering experiments (Table 5.1). The shale has moderately high total sulfur (0.90 to 0.93 weight percent) and moderate NP values. Although the shale is classified as a “gray zone” sample for AMD predictions, it is associated with alkaline mine drainage throughout the bituminous coal region of Pennsylvania (Brady et al., 1998).

The Brush Creek Shale sample contained very little organic material based on whole-rock low-temperature ash (100 weight percent) and loss-on-ignition (12 weight percent LOI). Many of the rock chips were fossil-rich; some contain inclusions of calcite or barite (Figures 5.15 and 5.16). Some rock chips show a prominent rock fabric, with elongated mineral grains and black inclusions that contain variable amounts of organic material and pyrite framboids (Figure 5.17). Pyrite framboids had complex internal structures composed of individual pyrite grains ranging from <1 micrometer to 10 micrometers or more (Figure 5.18).

The mineralogical composition of the shale (in weight percent) is: 34 % quartz, 37% micas and clay minerals, 11% chlorite, 2% feldspar, 3% pyrite, and 10% carbonate minerals (Table 5.4). The carbonate minerals include calcite, ankerite, and siderite. Although the carbonate minerals are a minor component of the rock, the XRD pattern for siderite is distinct from that of calcite or ankerite/dolomite. Three separate samples of the composite shale were analyzed by XRD to examine shale heterogeneity and reproducibility of quantitative XRD results. Statistical errors associated with the Rietveld refinement of each pattern are represented by the error of fit (Table 5.5); errors associated with each mineral are  $\pm 1.4$  weight percent or less. The spread in estimates indicates sample heterogeneity as well as systematic errors in sample preparation and XRD methodology.