TONSTEINS: POSSIBLE STRATIGRAPHIC CORRELATION AIDS IN EAST KOOTENAY COALFIELDS (82G/15, 82J/2)

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INTRODUCTION

Tonsteins are kaolinitic fine-grained sedimentary rocks associated with coal and coal-bearing strata; they are superficially similar to the shale partings found in most coal seams. Tonsteins are normally thin, but often have considerable areal extent, a factor which has made them extremely useful as correlation tools in many coalfields.

The term 'tonstein' does not, strictly speaking, imply any particular mode of formation. Much recent work suggests that many tonsteins are the end product of the reworking and/or alteration of volcanic ash (for example, Price and Duff, 1969; also *see* paper by Kilby, this volume). Work is at present too preliminary to allow genetic classification of the samples from southeast British Columbia discussed here.

Presence of tonsteins in the Balmer (No. 10) seam in the Sparwood area was reported by Mériaux (1972). During reconnaissance mapping in the south half of the Elk Valley Coalfield (Grieve, 1982; Grieve and Fraser, 1983), samples were taken of unusual-looking argillaceous partings from several coal seams. Thin-section and X-ray diffraction analysis of one example from the Ewin Pass property revealed a texture and mineralogy consistent with tonstein lithologies.

As a follow-up it was decided to test the local continuity of two of the discoveries to assess the potential of using tonsteins for regional stratigraphic correlation in the East Kootenay Coalfields. The current lack of known regionally extensive marker horizons in the coalfields is a problem to geologists in exploration and mining; this was an incentive for conducting this study.

Coal rights in the study area are held by Crows Nest Resources Ltd.

SAMPLE LOCATIONS

EWIN PASS: The Ewin Pass property is approximately 7 kilometres north of Line Creek (Fig. 11). The 1981 discovery of a tonstein (identification number 81-217) in 7(?) seam was made in the bank of a now-reclaimed exploration road (between lines 1200N and 1300N on the company grid). At the time a complete section of the coal-bearing Mist Mountain Formation was measured, which included this same exposure (*see* Grieve, 1982, Fig. 2). For this follow-up study, a new partial section was measured approximately 1 400 metres to the north, on an open, east-facing slope. The section measured is believed, from both the author's and the company geologists' detailed mapping, to correspond to the interval between 8 seam and 5 seam (local nomenclature only). Corresponding portions of both sections are plotted on Figure 12. A tonstein occurs in a coal seam at the same relative stratigraphic position (identification number 83-10). No other tonsteins were noted.

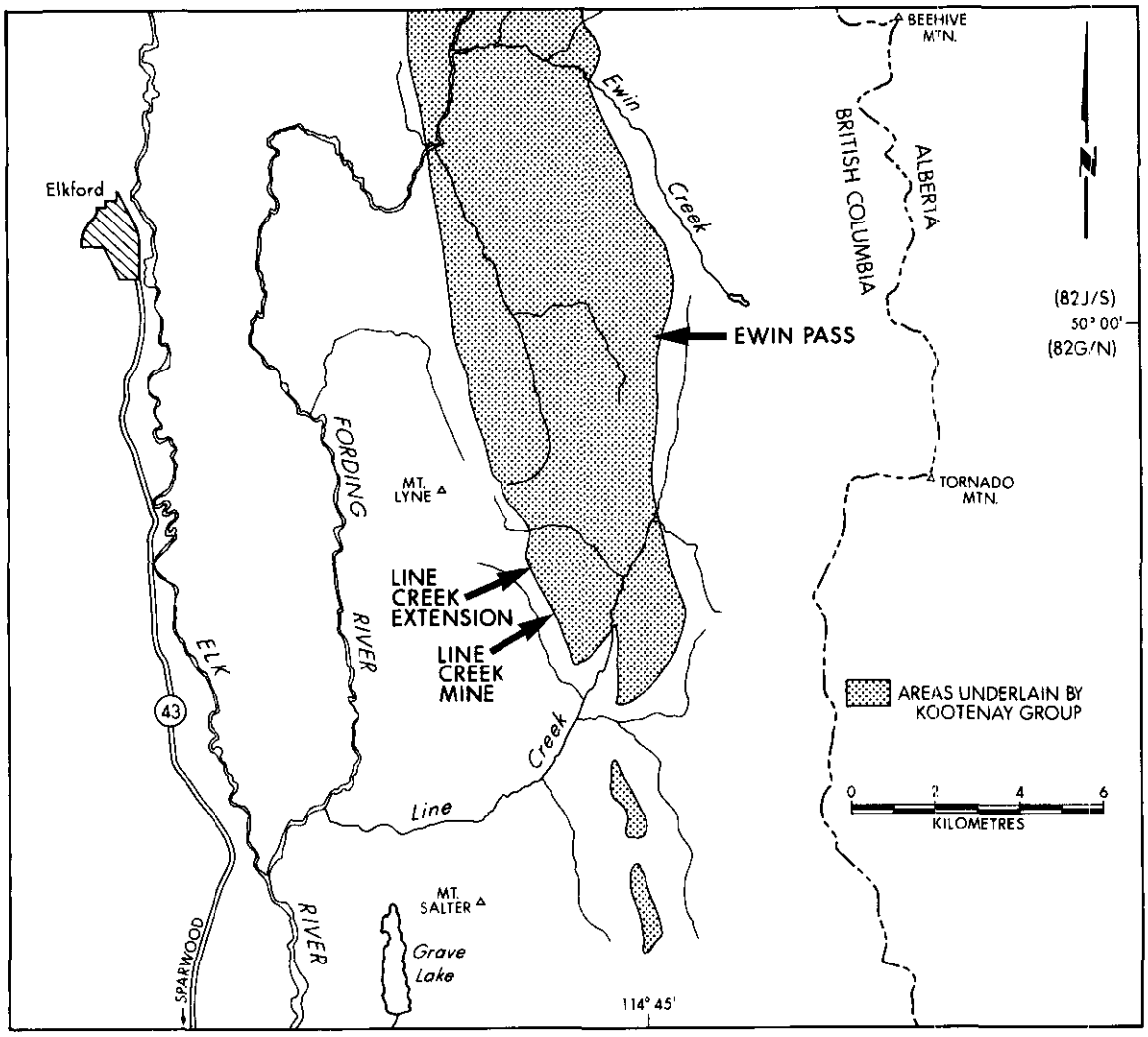

Figure 11. Line Creek area, Elk Valley Coalfield.

LINE CREEK RIDGE: Line Creek Ridge is the site of Crows Nest Resources' Line Creek mine, and its so-called Line Creek Extension property (Fig. 11). A closely spaced pair of tonsteins was found at an adit site in 10B seam on the Line Creek Extension (identification number 82-146). A nearly identical pair also occurs at the same stratigraphic level in the high-wall of Line Creek mine, 1.4 kilometres to the south (identification number 83-18B). At the mine two other tonsteins were noted, one overlying the double band by 140 centimetres and the other underlying by 15 centimetres. They are not included in the following descriptions and discussion.

DESCRIPTION OF SAMPLES

Thickness of the Ewin Pass tonsteins (numbers 81-217 and 83-10) averages 5 to 6 centimetres. Their colour is brownish black, with irregular dark brown patches; streak is also brown. They are very fine grained with visible, light grey rounded blebs (up to 0.5 millimetre) scattered randomly throughout. Lack of laminations or internal partings and two well-developed, closely spaced sets of fractures, both perpendicular to bedding, make these rocks distinctive. The fractures impart a distinctive blocky appearance in outcrop and float. Some of the samples display a conchoidal breakage fracture.

TABLE 1
TRACE ELEMENT CONTENT (%) OF LINE CREEK AREA TONSTEIN SAMPLES
(SEMIQUANTITATIVE)

	81-217	83-10	82-146	83-18B
Li	---	Trace	---	---
B	Trace	Trace	Trace	Trace
P	>>3.0	>5.0	Trace	Trace
Sc	---	---	Trace	Trace
Ti	0.35	0.2	0.4	1.7
V	Trace	---	Trace	Trace
Cr	Trace	---	Trace	---
Mn	---	Trace	Trace	Trace
Co	---	---	---	0.007
Ni	---	---	---	0.006
Cu	Trace	Trace	Trace	Trace
Zn	---	---	---	Trace
Ga	Trace	Trace	Trace	Trace
Sr	0.5	0.5	Trace	Trace
Y	Trace	Trace	Trace	Trace
Zr	Trace	Trace	---	---
Mo	---	---	---	Trace
Ag	---	---	---	Trace
Ba	0.75	>2.0	<0.05	<0.05
La	0.01	---	---	---
Ce	---	---	---	Trace
Yb	Trace	Trace	Trace	Trace
W	---	---	Trace	---
Pb	0.04	Trace	Trace	Trace

TABLE 2
OXIDE ANALYSIS OF EWIN PASS TONSTEIN
(81-217)

	Per Cent
SiO_2	35.52
Al_2O_3	34.45
Fe_2O_3	<0.10
FeO	<0.3
MgO	<0.05
CaO	0.22
Na_2O	<0.02
K_2O	<0.03
TiO_2	1.020
MnO	<0.002
Total H_2O	14.38
S	0.09
P_2O_5	4.5
SrO	>0.5
BaO	>0.5
CO_2	9.09

The two bands in the Line Creek Extension locality (number 82-146) are separated by 1.2 centimetres of dark grey, very fine-grained carbonaceous rock. The lower tonstein, which is 1.2 centimetres thick, is medium brown with black carbonaceous stringers; it has a white streak. It is very fine grained and has two regular sets of fractures, similar to those in Ewin Pass samples. Some fracture planes have a vitreous lustre. Rounded light grey blebs up to 2 millimetres in size are concentrated near the contacts of the band, and also occur in the enclosing 4 to 5 millimetres of dark grey carbonaceous rock. The band is very difficult to physically separate from its enclosing rock. The upper band is 5 millimetres thick, is medium brownish grey, and has a white streak.

The pair of tonstein bands in Line Creek mine high-wall (number 83-18B) are separated by 1 centimetre of carbonaceous rock. The lower brown band is 1 centimetre in thickness, but in all other respects is identical to the corresponding unit described previously.

PETROGRAPHY OF SAMPLES

Petrographic examinations were necessarily supplemented by X-ray diffraction analyses. Both Ewin Pass samples are characterized by a microcrystalline groundmass of gorceixite [$BaAl_3(PO_4)_2(OH)_5 \cdot H_2O$] with or without kaolinite, with thin stringers of organic material, and with minor amounts of euhedral apatite crystals. Irregular subrounded ovoid bodies of microsrystalline kaolinite containing minor amounts of gorceixite, known as 'graupen', occur throughout. Their long axes generally lie in the bedding plane. In hand specimen the graupen form light grey blebs. Some of the kaolinite in the graupen is in vermicular form.

Only the lower brown band from the Line Creek Ridge samples was examined. Microcrystalline kaolinite forms the groundmass; it is cut by stringers of organic matter and carries angular to subrounded apatite clasts, rare euhedral apatite crystals, and subangular quartz clasts. Many of the quartz clasts have diffuse, corroded outlines. Sample 83-18B also has rare plagioclase (?) laths. Graupen with highly irregular outlines are most abundant near the margins of the band. They are composed of microcrystalline kaolinite, some of which is vermicular. The organic stringers bend around the graupen.

Contact with the enclosing dark rock is sharp; it is marked by the sudden occurrence of thick stringers of organic material (liptinite ?) separated by elongated, flattened graupen and kaolinitic groundmass material. This corresponds with observations in hand specimen that graupen occur both within the brown band and in the enclosing rock, and that the brown band is very difficult to physically separate from its immediate enclosing rock.

CHEMISTRY OF SAMPLES

Semiquantitative emission spectrographic trace element analyses of four samples are listed in Table 1; an oxide analysis of 81-217 is given in Table 2. Notably all have high titanium values (0.2 to 1.7 per cent). Trace amounts of boron, copper, gallium, yttrium, ytterbium, and lead are also common to all samples analysed.

Relatively higher values of phosphorus and barium in the Ewin Pass samples reflect the mineral gorceixite; perhaps it also accounts for relatively high strontium contents (assuming some solid solution between gorceixite and goyazite [$SrAl_3(PO_4)_2(OH)_5 \cdot H_2O$].

Trace zirconium is restricted to the Ewin Pass samples, while trace scandium is restricted to the Line Creek Ridge samples. Analyses were semiquantitative; these values may not be significant.

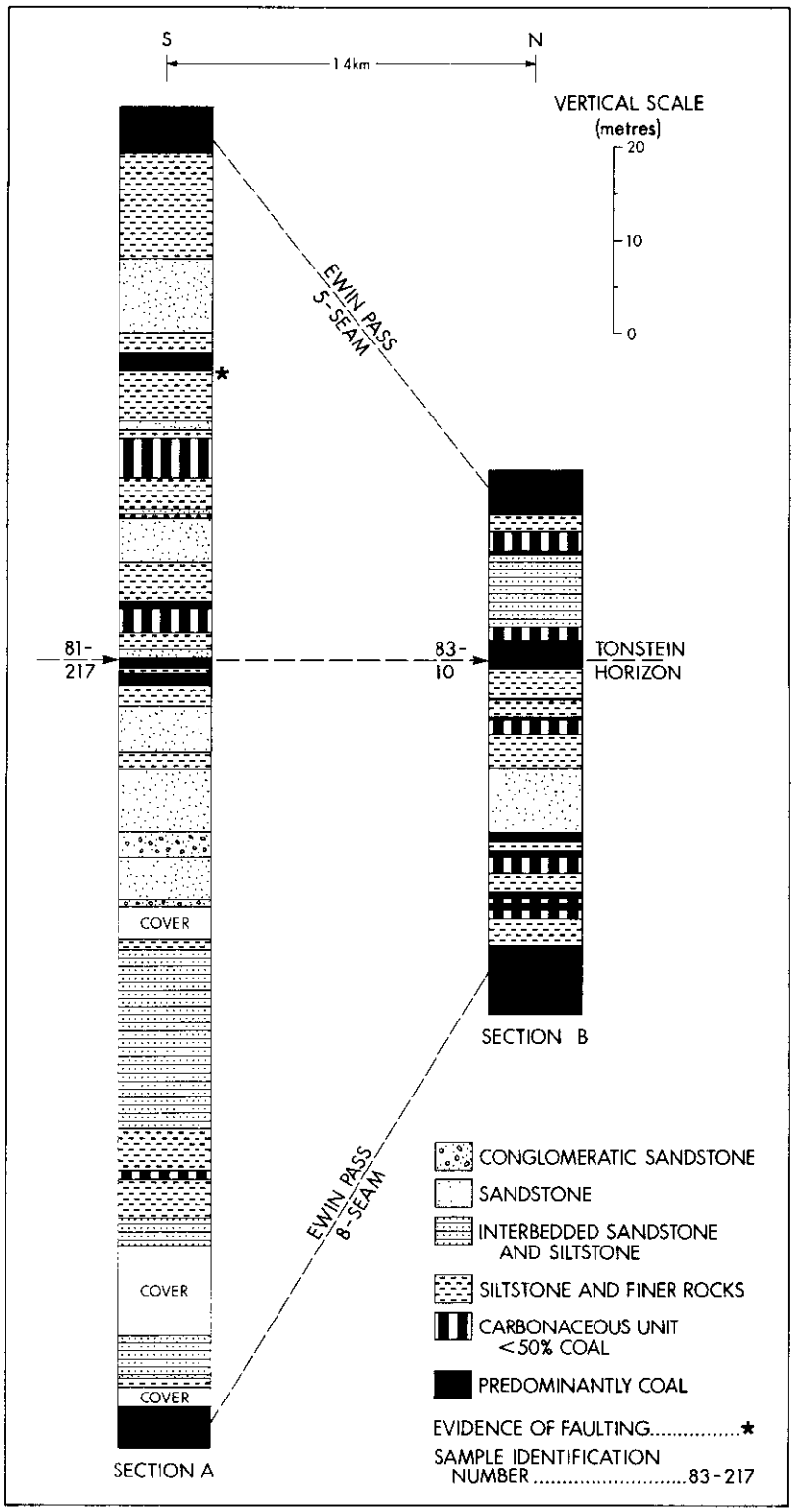

Figure 12. Detailed stratigraphic sections from two locations on Ewin Pass property showing mapped correlations of 5 seam and 8 seam and proposed correlation of tonstein horizon.

Other elements detected include lithium, vanadium, chromium, manganese, cobalt, zinc, molybdenum, silver, lanthanum, cerium, and tungsten.

DISCUSSION

Preliminary work suggests that tonsteins have potential as stratigraphic correlation tools in the East Kootenay Coalfields. The occurrence of a double band of tonsteins with very similar characteristics at the same relative stratigraphic level at both Line Creek Ridge and Line Creek Extension is impressive evidence for at least local lateral persistence of the tonsteins; further it demonstrates the utility of simple macroscopic parameters, such as colour, thickness, and grouping of bands. On the Ewin Pass property, discovery of a tonstein at the same relative stratigraphic position at two locations emphasizes the potential of tonsteins to aid in stratigraphic correlation. The proposed correlation is reinforced by the presence of gorceixite at both locations.

In both cases cited a certain amount of stratigraphic control was utilized in deciding where to search for second occurrences of the tonsteins. On a regional scale, where stratigraphic control is often non-existent, petrographic and chemical criteria may prove to be key elements in identification and correlation of specific tonsteins.

As an aside, the marked contrast in thicknesses of the two 8-seam to 5-seam intervals measured on Ewin Pass (Fig. 12) mainly results from facies changes. Faulting recognized in the area of the more southerly section (one zone was noted) may also occur in covered intervals and account for some of this difference. For correlation under such geological conditions the need for reliable regional markers, like tonsteins, is great. Further work will be directed toward determining abundance, regional extent, composition, and origin of tonsteins in the East Kootenay Coalfields.

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