



Clear Hills Ironstone and Coal Resources - 2004 Digital Compilation and Some Geochemical and Geological Highlights from 2004 Fieldwork

Clear Hills Ironstone and Coal Resources - 2004 Digital Compilation and Some Geochemical and Geological Highlights from 2004 Fieldwork

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Abstract

The Clear Hills oolitic ironstone was initially discovered during the 1920s, re-discovered in the early 1950s, and extensive exploration and government geoscience work was conducted locally in the southern and eastern Clear Hills region from the late 1950s into the early 1970s. Since then, only sporadic exploration and little government geoscience work has been done. As a result of the 1950s to 1970s work, a resource of at least 1.1 billion tonnes grading 32% to 36% iron was identified (Bertram & Mellon, 1975). The oolitic ironstones are in the Bad Heart Formation which, based on biostratigraphic work done by Dr. C. Collom (2000) along the Smoky River, is of late Coniacian age (~86.5 to 85.5 Ma). Hamilton (1980) reported the ironstone comprises a dark brown to green-black, ferruginous oolitic zone in a bed that is up to about 10 m thick at Rambling River on the eastern margins of the Clear Hills. Prior work has indicated the oolitic horizon is thickest in the northeast near Rambling River, but thins to the west to a zero edge as the oolitic ironstone passes laterally into equivalent Bad Heart Formation siltstone-sandstone. It has been suggested (Ibid) that the Clear Hills deposit is 'Minette-type' oolitic ironstone; it consists of densely packed ooliths with the matrix comprised of illite and nontronite imbedded in a ferruginous opaline and sideritic cement.

During summer 2004 the AGS re-visited and precisely re-located many of the reported Bad Heart and oolitic ironstone exposures that were identified by Kidd (1959). At selected sites, geological examinations and systematic rock chip sampling were performed. In total, 151 rock samples (including 7 duplicates and 7 standards) were collected and submitted for geochemical analyses. These samples were collected from 5 sites in the southern Clear Hills, 4 sites near the hamlets of Spirit River and Wanham, and 15 sites along the Smoky River. The primary intent of this sampling is to provide a preliminary litho-geochemical characterization of the oolitic ironstones (based on 'oxidized' surface material) to supplement previous litho-geochemical work reported by Olson et al. (1999) and some other workers. It is anticipated that this new litho-geochemical information will be released sometime during 2005.

During the latter half of 2004, the AGS collaboratively compiled (with some financial support from Clear Hills Iron Ltd.) digital information about ironstone and coal in the Clear Hills – Smoky River region from publicly available sources. The sources included selected assessment reports; oil, gas and water wells; exploratory coal holes and some other documents. These data will be publicly released during 2005 as an AGS Geonote. The digital data and information in this Geonote are being released as two CDs that will include an ArcExplorer project to facilitate viewing selected data without the need for purchase of any software.

With respect to potential coal resources in the Clear Hills region, Alberta Energy & Utilities Board (Dec. 1993 Reserves of Coal Report) identified an 'initial in-place resource' estimate of about 240 million tonnes of lignitic 'A' coal in two seams in late Late Cretaceous Wapiti Formation. During winter 2004-2005, Sneddon has been working up the coal resources in the Clear Hills Region. This work has indicated there are several potential coal targets and these exist in sub-basins that are possibly separated by several known and inferred faults. The coal is believed to occur as stacked, discontinuous seams of varying quality. As a result, exploration will be needed to (a) identify those coal resources that are both of highest quality and largest size and (b) identify those locales in the Clear Hills region where there is spatial overlap of mineable resources of ironstone as well as potentially mineable resources of coal.

J.Weiss¹, R.A. Olson¹ and D.T. Sneddon²

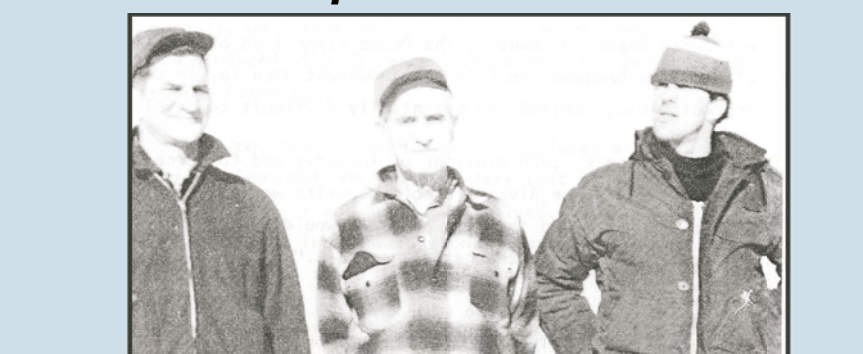
1. Alberta Geological Survey, Alberta Energy and Utilities Board, 4th Floor, Twin Atria Building, 4999 - 98 Ave., Edmonton, Alberta, T6B 2X3
 2. Marmot Research Inc., 31 Hawkfield Dr. N.W., Calgary, Alberta, T3G 2G8

Exploration History

The Clear Hills oolitic ironstone was initially discovered during the 1920s, re-discovered in the early 1950s, and extensive exploration and government geoscience work was conducted locally in the southern and eastern Clear Hills region from the late 1950s into the early 1970s. Since then, only sporadic exploration and little government geoscience work has been done. As a result of the 1950s to 1970s work, a resource of at least 1.1 billion tonnes grading 32% to 36% iron was identified (Bertram & Mellon, 1975).



Pack Train returning from deposit in 1925



Cliff Chalmers (one of the initial discoverers seen above) and sons (1943)

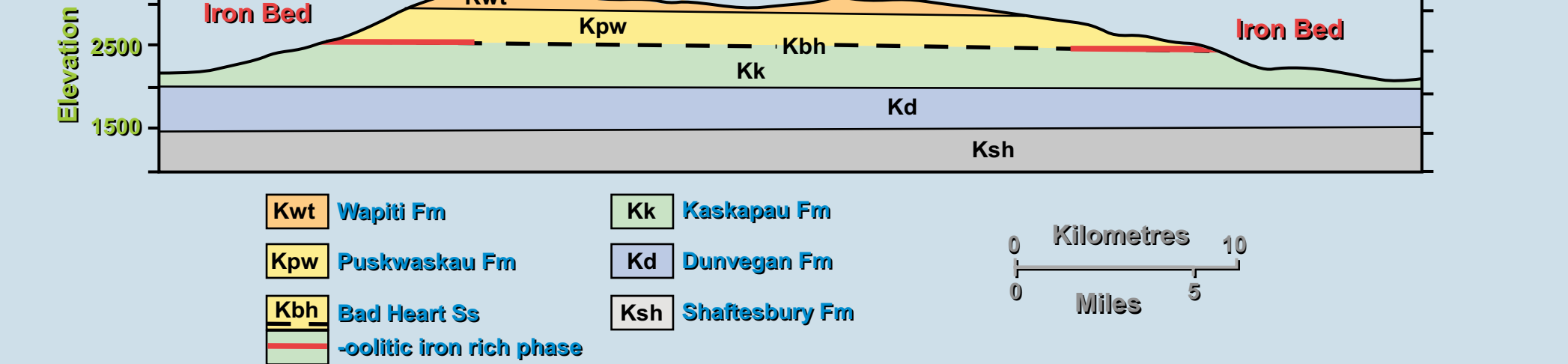
Block Name	Resource (million tonnes)	Avg Grade (% Fe)	Avg Thickness (m)
Worsley (A)	30.8	32.6%	2.4
Rambling (Swift) Creek (B)	~163.3	~34.7%	~6.0
Whitemud River (C)	620.3	34%	5.2
South Whitemud River (D)	186.0	34%	3.4
TOTAL	~1 billion	~34%	2.4 to 5.0

(from Hamilton, 1980)

The oolitic ironstones are in the Bad Heart Formation which, based on biostratigraphic work done by Dr. C. Collom (2001) along the Smoky River, is of late Cretaceous age (~86.5 to 85.5 Ma). Hamilton (1980) reported the ironstone comprises a dark brown to green-black, ferruginous oolitic zone in a bed that is up to about 10 m thick at Rambling River on the eastern margins of the Clear Hills. Prior work has indicated the oolitic horizon is thickest in the northeast near Rambling River, but thins to a zero edge as the oolitic ironstone passes laterally into equivalent Bad Heart Formation siltstone-sandstone. It has been suggested (Ibid) that the Clear Hills deposit is a 'minette-type' oolitic ironstone; it consists of densely packed ooliths with the matrix comprised of illite and nontronite imbedded in a ferruginous opaline and sideritic cement.

(from Green and Mellon, 1962)

(from Green and Mellon, 1962)



Idealized cross section - Worsley to Rambling River

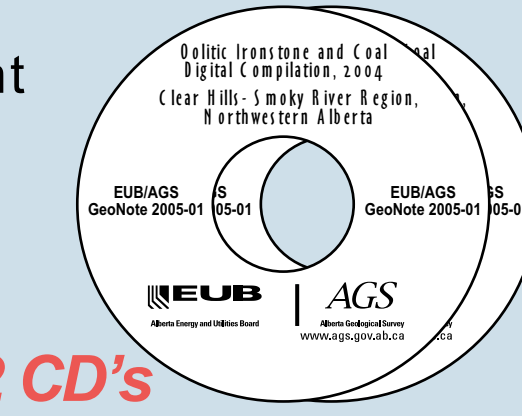
2004 Compilation

During the latter half of 2004, the AGS collaboratively compiled (with some financial support from Clear Hills Iron Ltd.) digital information about ironstone and coal in the Clear Hills - Smoky River region from publicly available sources. The sources included selected assessment reports; oil, gas and water wells; exploratory coal holes and some other documents.



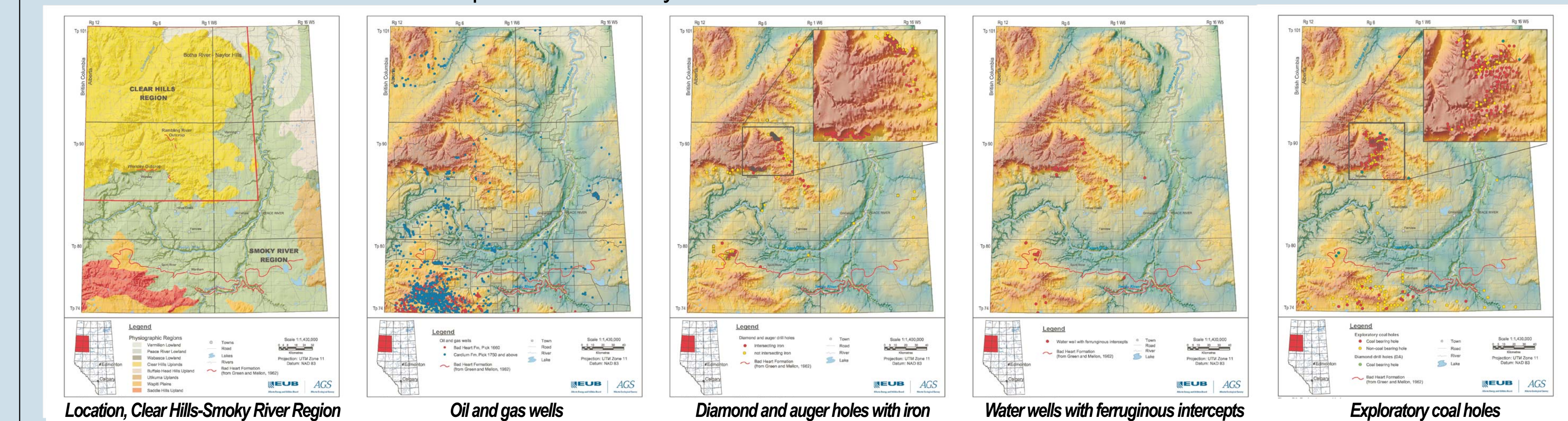
Release May 2005

- The digital compilation has shown that there are
- 66 publicly available assessment reports on file with AGS that contain pertinent information about prior exploration
 - 36 AGS publications or maps
 - 18 Geological Survey of Canada (GSC) publications or maps
 - 340 diamond-drill and auger mineral exploration holes
 - 230 coal holes (96 intersecting coal)
 - 5432 water wells (80 intersecting Bad Heart ironstones, 109 intersect coal)
 - 18 019 oil/gas wells (162 with stratigraphic pick information about the Bad Heart specifically)

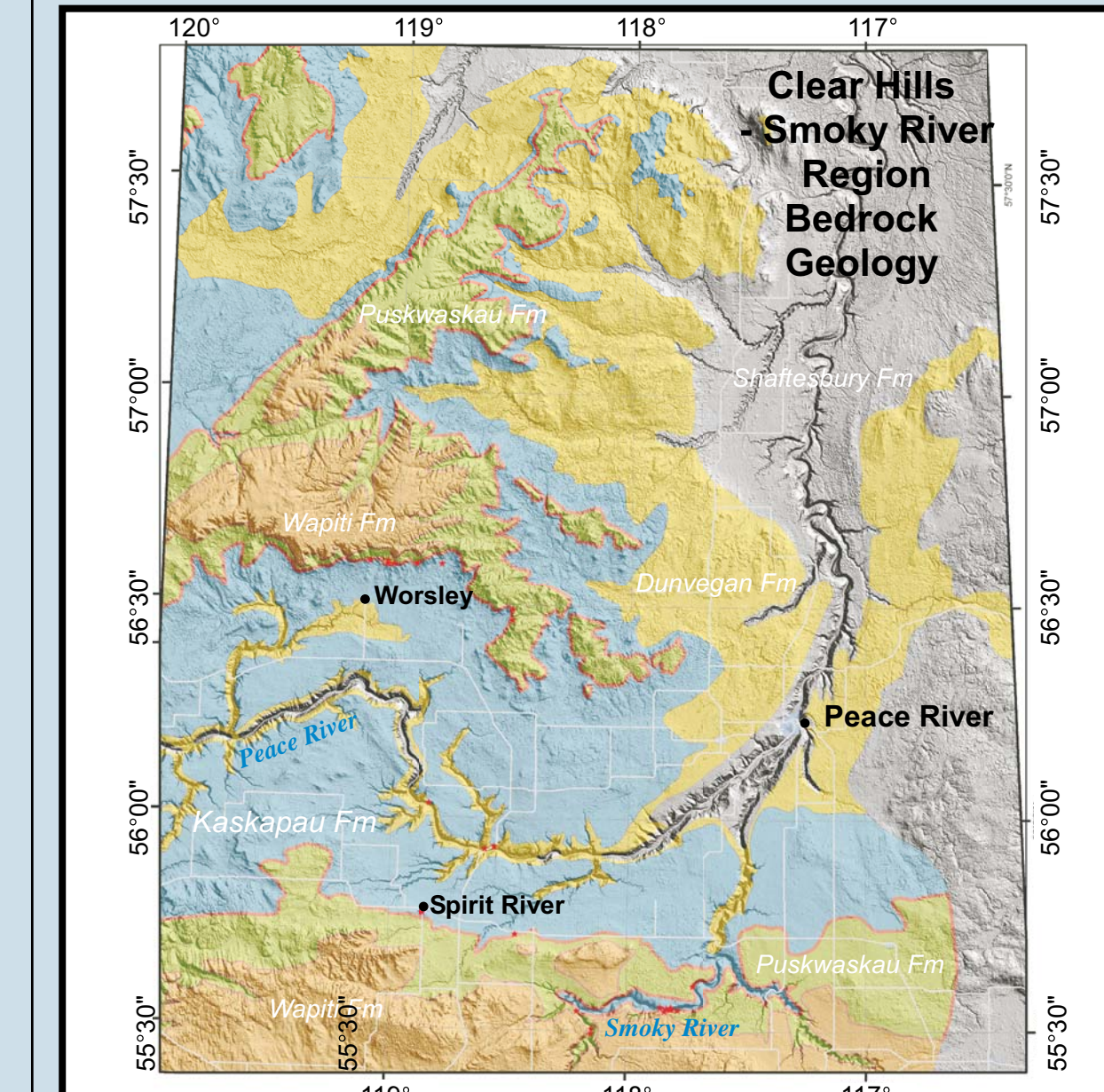
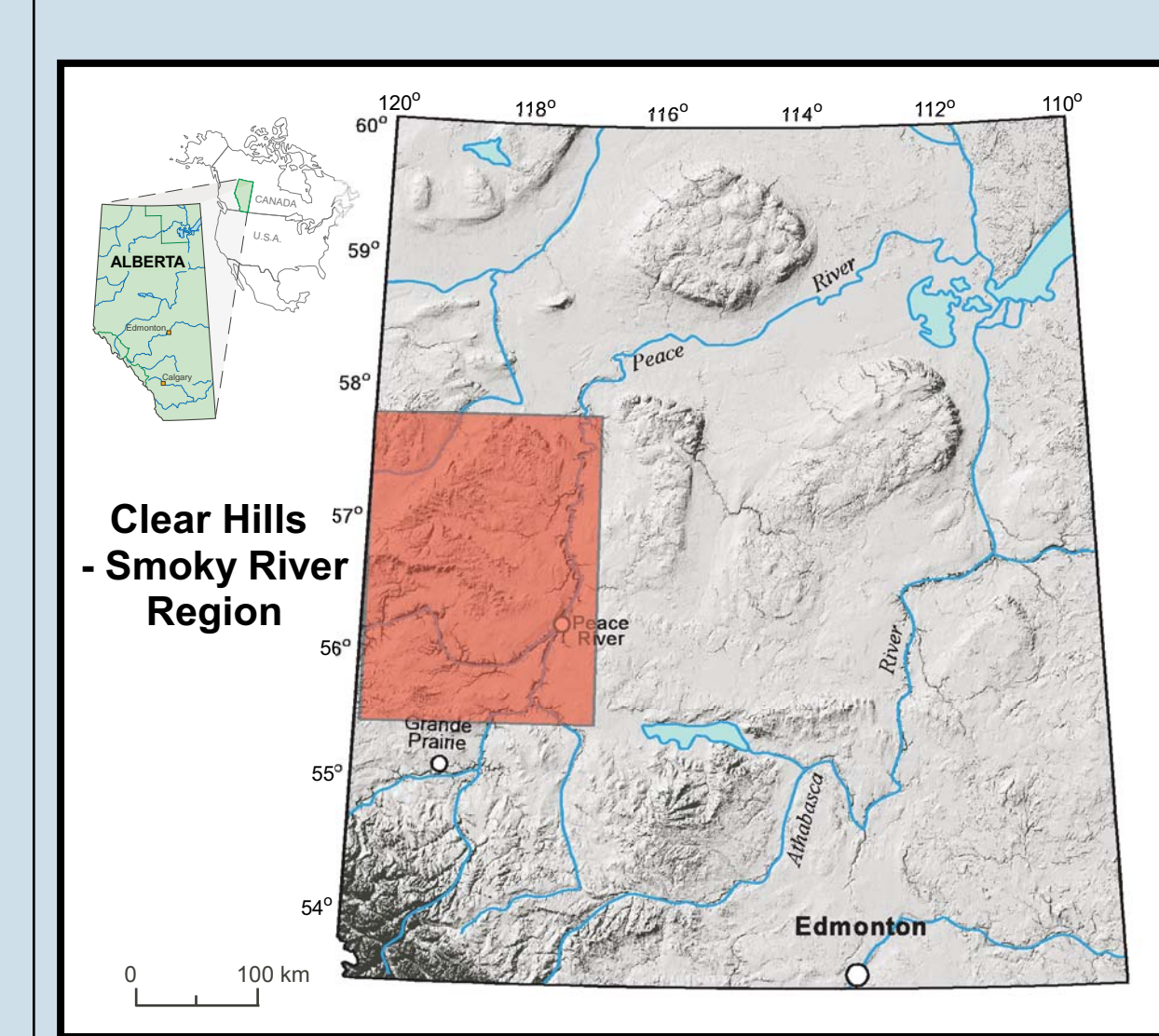


2 CD's

These data will be publicly released during the first half of 2005 as AGS Geonote 2005-01. The digital data and information in this Geonote are being released as two CDs that will include an ArcExplorer project to facilitate viewing selected data without the need for purchase of any software.



Study Area



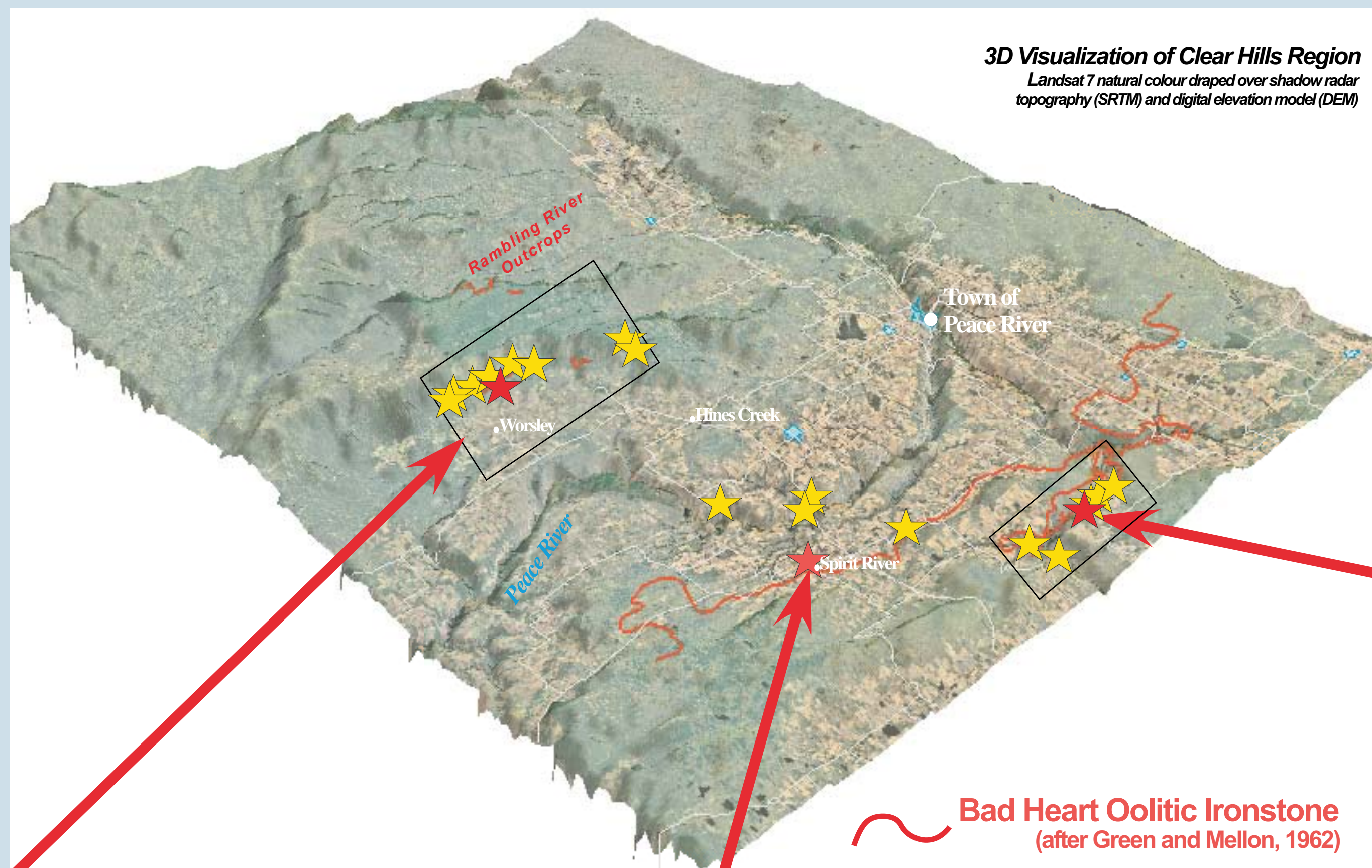
(from Green and Mellon, 1962)

Rock Unit	Thickness (m)	Lithology
Wapiti Fm	0 - 120	Sandstone, shale, thin coal seams
Puskwaskau Fm	90 - 190	Dark grey fissile shale (Marine)
Bad Heart Sandstone	0 - 5	Ferruginous oolitic sandstone, calcareous & mudstone (Marine)
Kaskapau Fm	~55 - 170	Upper Mbr: red to dark grey fissile shale; Lower Mbr: grey sandy shale & siltstone (Marine)
Dunvegan Fm	150 - 235	Soft, grey sandstone, coconcretionary; grey carbonaceous shale (Deltaic)
Shaftesbury Fm	270 - 490	Grey to black shale, interbedded with fish scales in Lower Mbr (Marine)

Clear Hills Stratigraphy

Fieldwork 2004

During summer 2004 the AGS re-visited and precisely re-located about 50% of the reported Bad Heart and oolitic ironstone exposures that were identified by Kidd (1959). At selected sites, geological examinations and systematic rock chip sampling were performed. In total, 151 rock samples (including 7 duplicates and 7 standards) were collected and submitted for geochemical analyses. These samples were collected from 5 sites in the southern Clear Hills, 4 sites near the hamlets of Spirit River and Wanham, and 15 sites along the Smoky River. The primary intent of this sampling is to provide a preliminary lithochemical characterization of the oolitic ironstones (based on 'oxidized' surface material) to supplement previous lithochemical work reported by Olson et al. (1999) and some other workers. It is anticipated that this new lithochemical information will be released sometime during 2005.



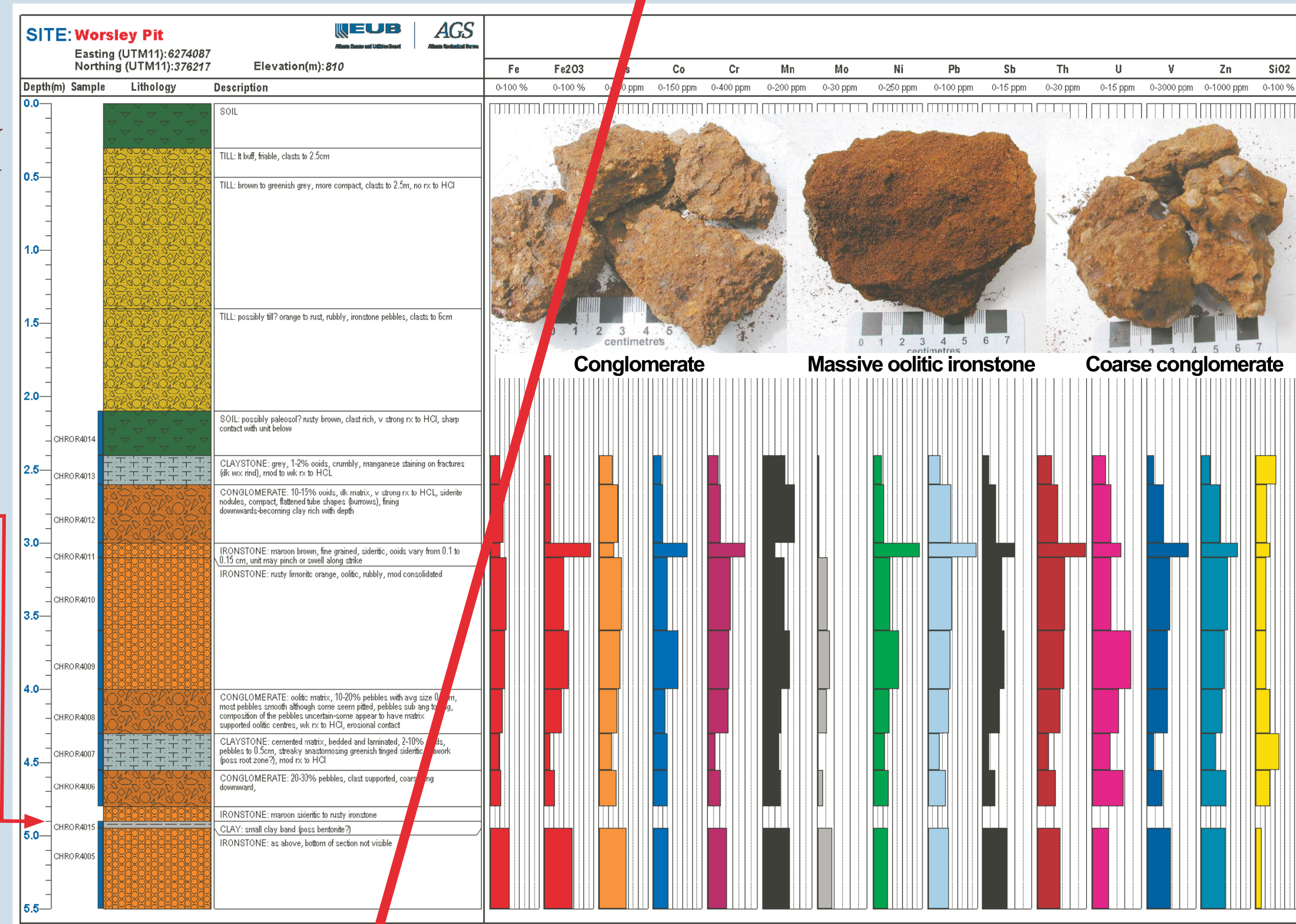
3D Visualization of Clear Hills Region
 Legend: 1 natural colour draped over shaded relief topography (SRTM) and digital elevation model (DEM)

Bad Heart Oolitic Ironstone (after Green and Mellon, 1962)



Worsley Pit

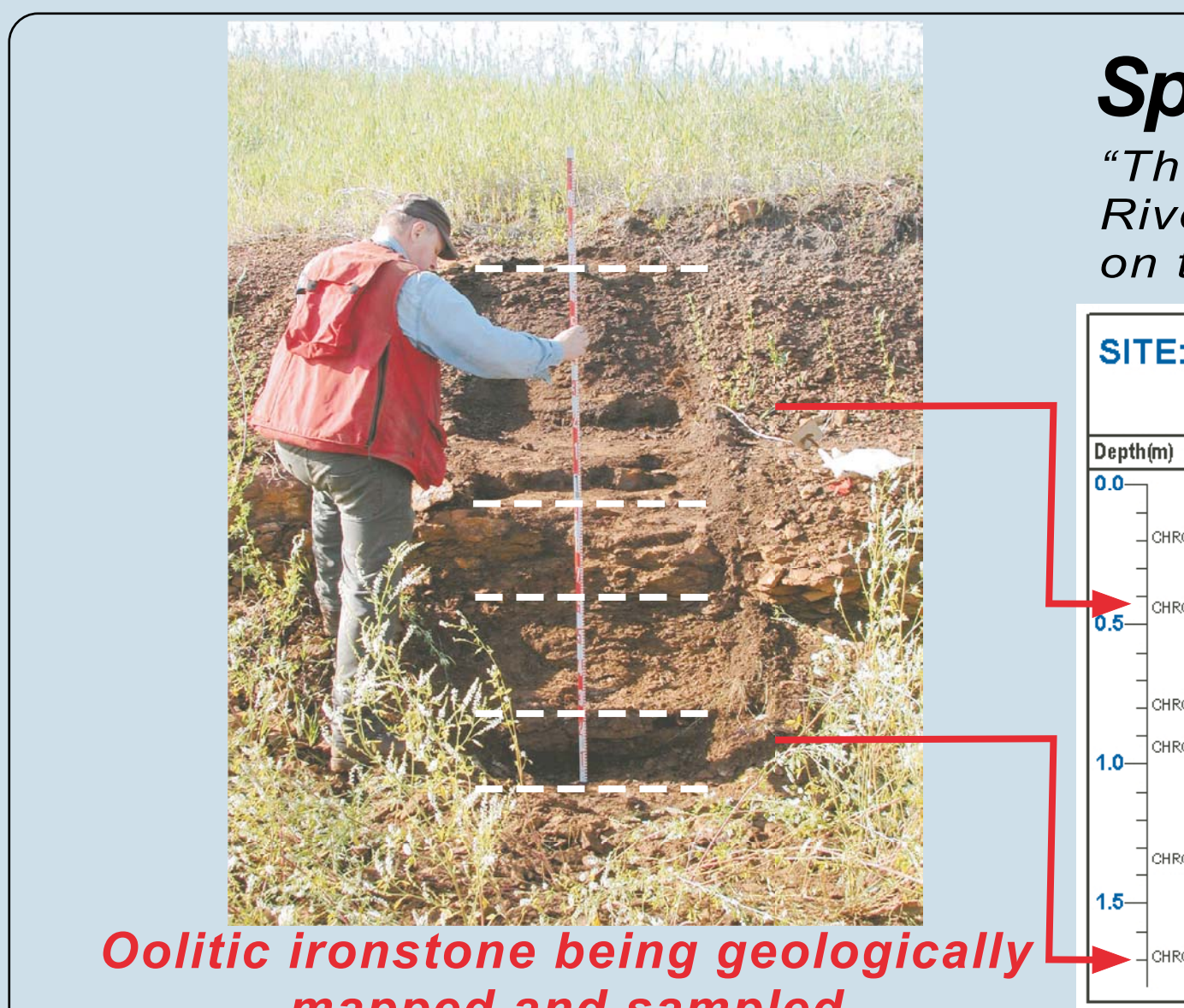
"Friable Red-weathering ferriferous sandstones can be traced in more than 15 outcrops along the southern slopes of the Clear Hills for approximately 37 miles (60km) at elevations about 2610 ft. [795m] and 2720 ft. [830m]. Most exposures are less than 100 ft. [30 m] long...with thicknesses of 30 ft. [9m] and average more than 7 ft. [2m]"
 KIDD, 1959



Conglomerate Massive oolitic ironstone Coarse conglomerate



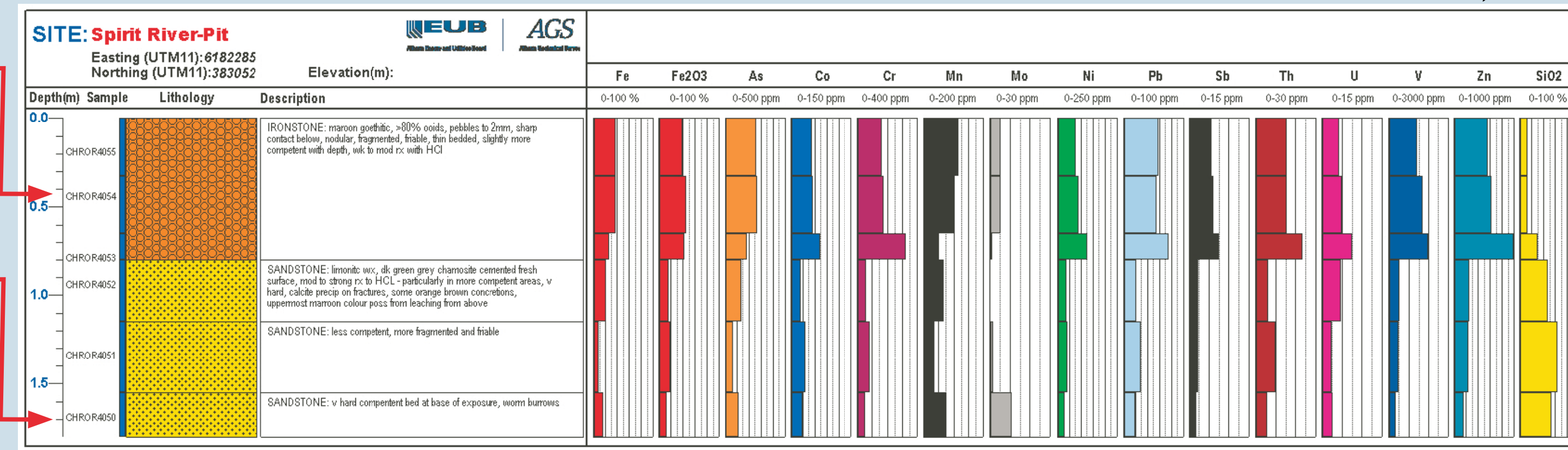
Clay seam in oolitic ironstone at Worsley pit locale



Oolitic ironstone being geologically mapped and sampled

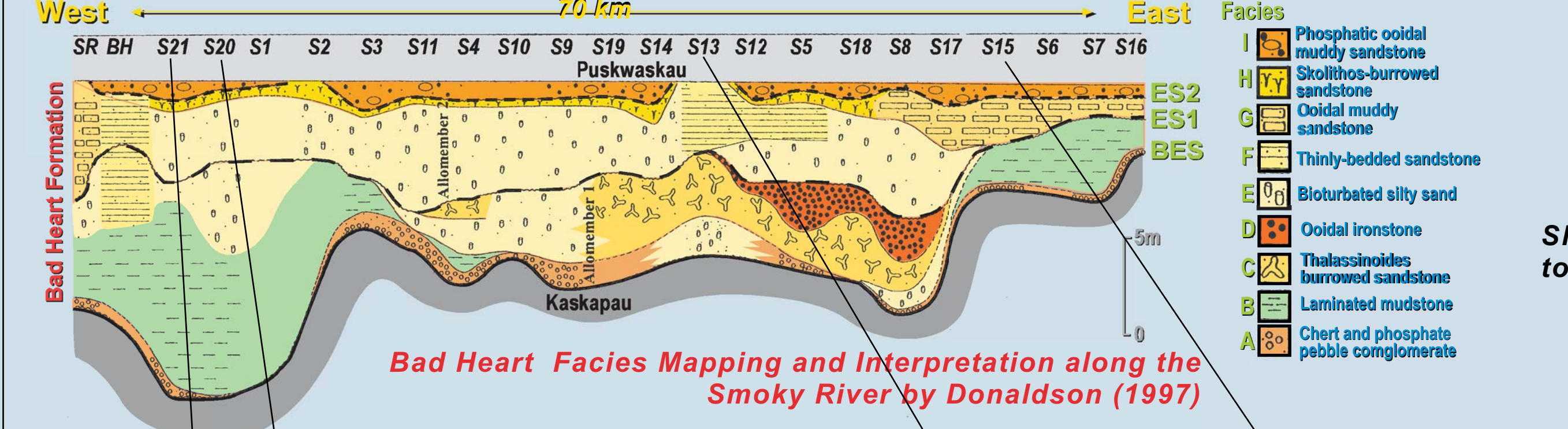
Spirit River Pit (material used as a local 'aggregate')

"The Bad Heart member forms an escarpment which extends eastward from the vicinity of Spirit River town to the Smoky River. The thickness increases from 15 ft. [5m] at Spirit River to 25 ft. [8m] on the Smoky."
 RUTHERFORD, 1930

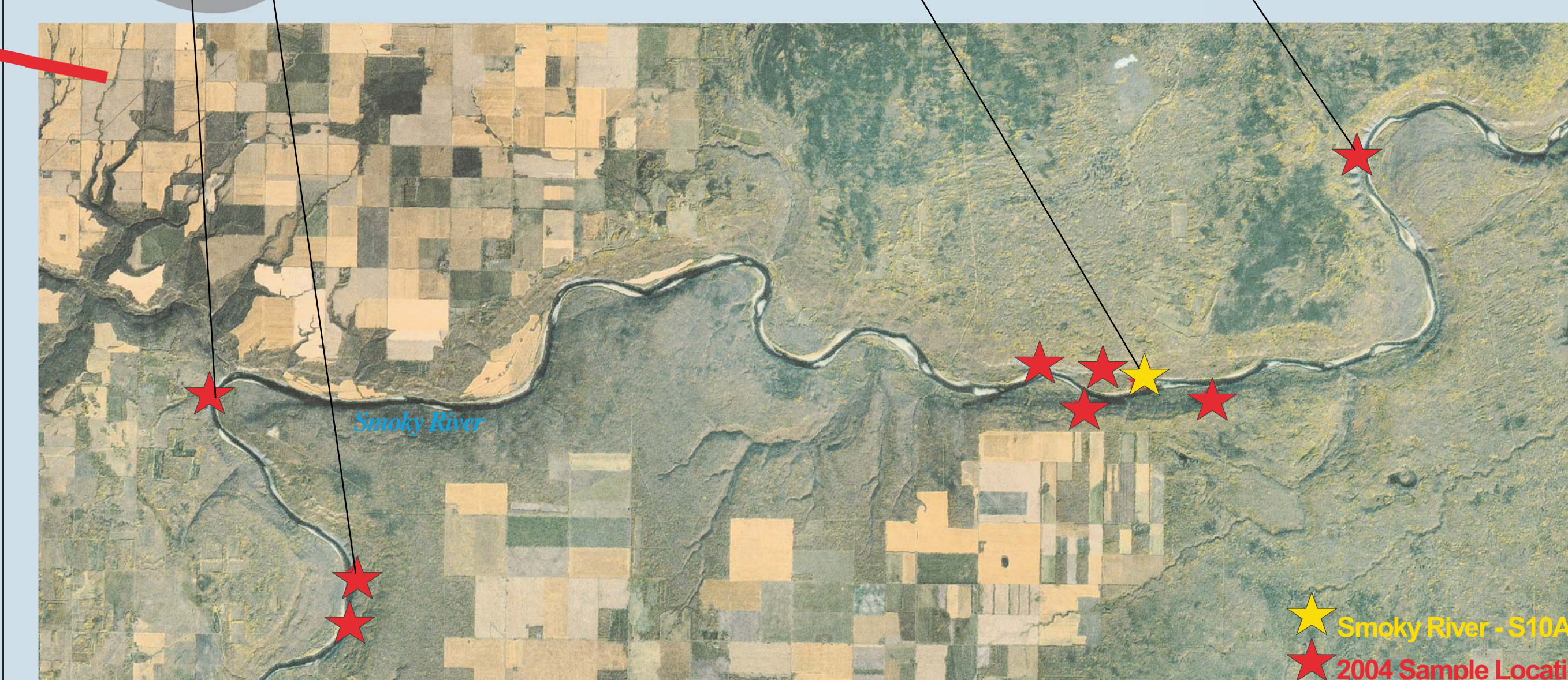


Smoky River

"The Bad Heart Sandstone member consists of 10 to 25 ft. [3 to 8 m] of coarse sandstone, weathering reddish brown. It stands out prominently in all the cliffs [along the Smoky River] from the Puskwaskau River to within a few miles of the Little Smoky River and forms a horizontal, frieze-like band in the cliffs of [the underlying Kaskapau and overlying Puskwaskau] shale. This member is abundantly fossiliferous"
 McLEARN, 1919

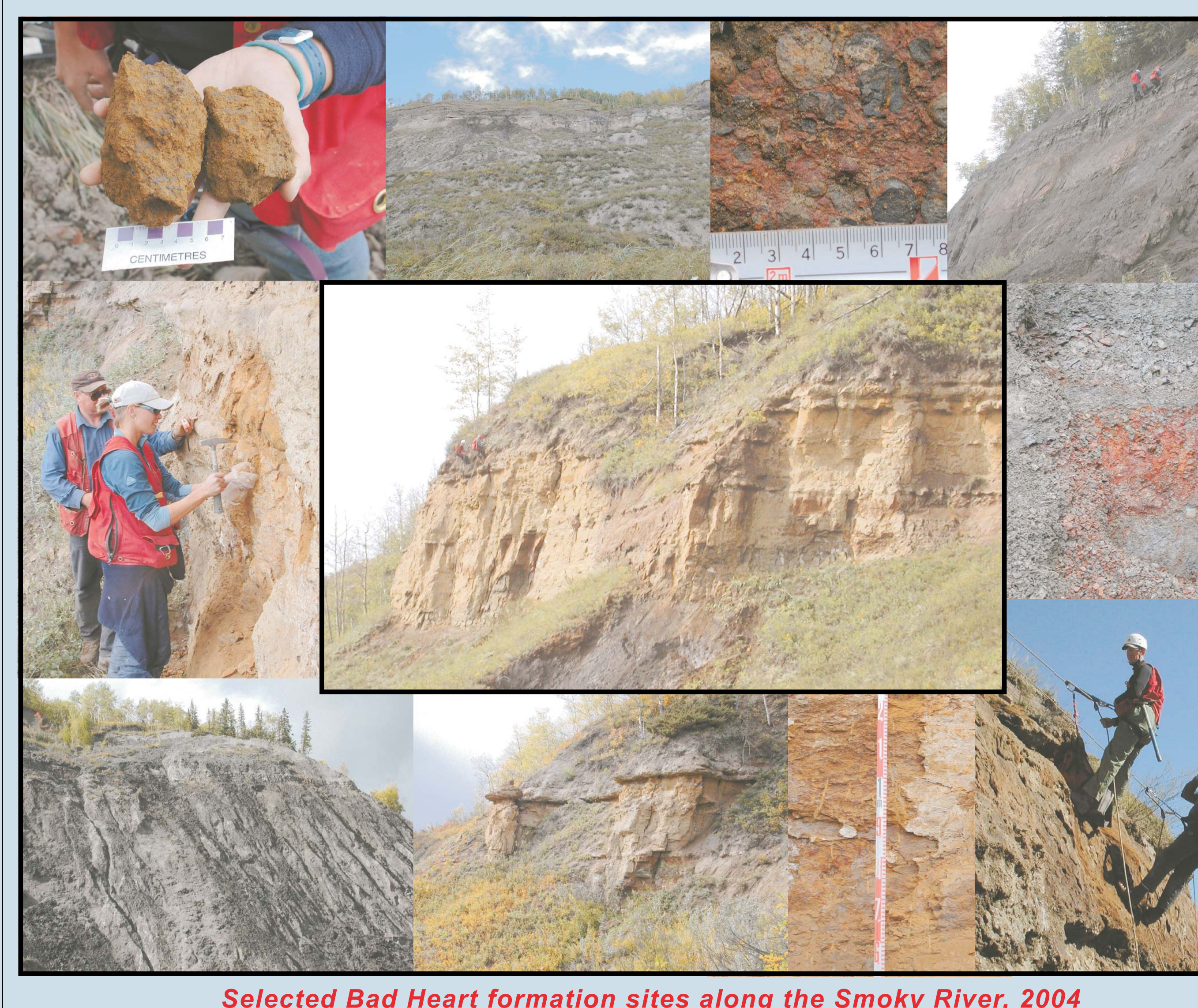


Bad Heart Facies Mapping and Interpretation along the Smoky River by Donaldson (1997)



Network of Trilobal Burrows

Skolithos Burrows

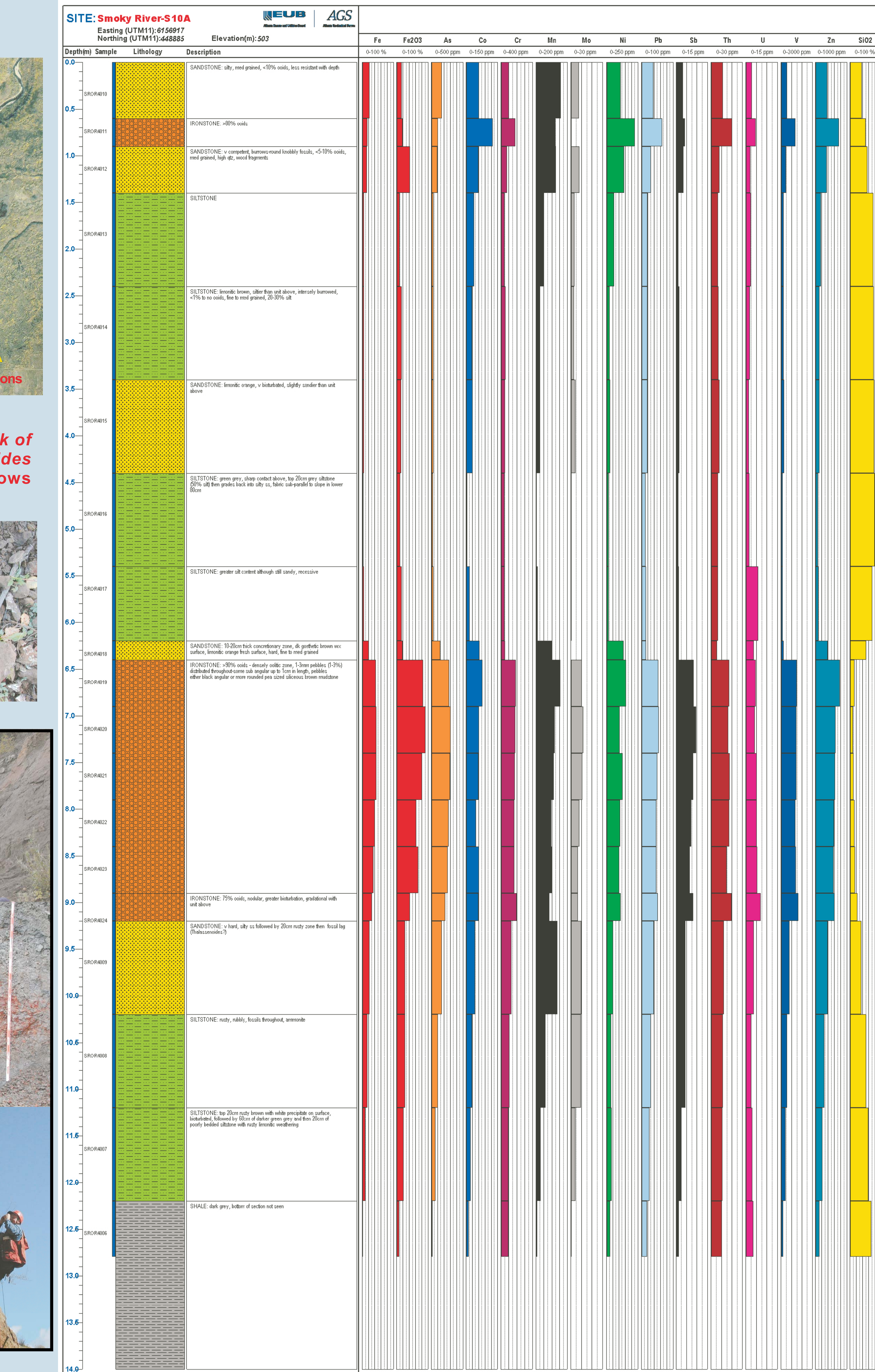


Selected Bad Heart formation sites along the Smoky River, 2004



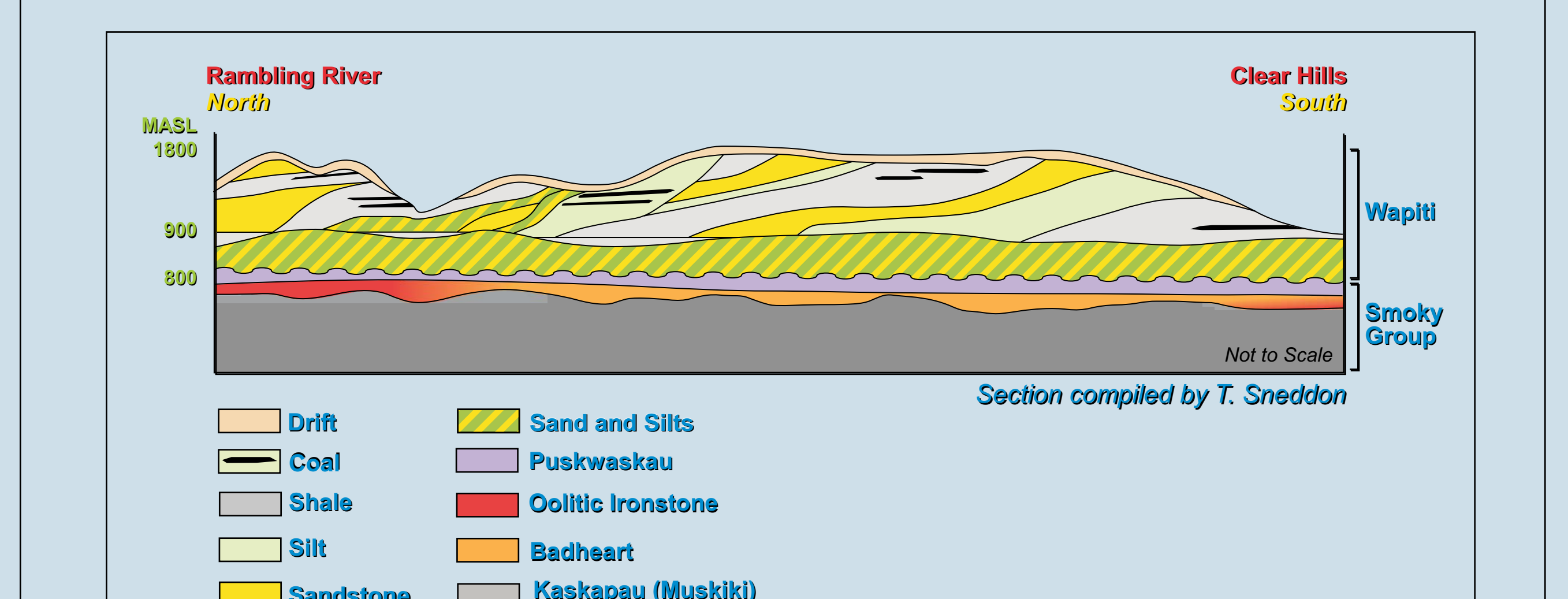
Slope analysis can be utilized to predict outcrop locations

Views along Smoky River showing trace of Bad Heart formation outcrop



Coal Resources

With respect to potential coal resources in the Clear Hills region, Alberta Energy & Utilities Board (Dec. 1993 Reserves of Coal Report) identified an 'initial in-place resource' estimate of about 240 million tonnes of lignitic 'A' coal in two seams in late Late Cretaceous Wapiti Formation. During winter 2004-2005, Sneddon has been working up the coal resources in the Clear Hills Region. This work has indicated there are several potential coal targets and these exist in sub-basins that are possibly separated by several known and inferred faults. The coal is believed to occur as stacked, discontinuous seams of varying quality. As a result, exploration will be needed to (a) identify those coal resources that are both of highest quality and largest size and (b) identify those locales in the Clear Hills region where there is spatial overlap of mineable resources of ironstone as well as potentially mineable resources of coal.



Clear Hills coal exposure

Tom Sneddon examining coal

This seam of coal underlain by Wapiti Fm sandstone

Moving Forward

Year	FY	Work Description
1	2004-05	(a) Locate selected Kidd (1959) ironstone locales
		(b) Examine & sample oolitic ironstone locales
		(c) Compile selected information into digital format
2	2005-06	(a) Continue location of Kidd (1959) ironstone locales
		(b) Trench selected locales at CH to obtain better stratigraphic and sampling information
		(c) Collect samples from/for collaborative partners
		(d) Preliminary evaluation of compiled digital data
3	2006-07	(a) Work with industry/government partners on selected stratigraphic, paleontologic, age dating and mineralogical studies
		(b) Continue selected trenching/drilling of a few locales in the Clear Hills region to provide a preliminary evaluation of resource geometry and grade variations
		(c) Continue work with collaborative partners on selected detailed aspects, including metallurgical studies
4+	2007 and beyond	(a) Ongoing studies will reflect the needs of industry and government for resource planning

References

See the soon to be released Geo-Note 2005-05 which includes a bibliography of publications pertinent to the Clear Hills Region.

Acknowledgements

The authors would like to thank Eleanor Alesi for her many hours compiling data from assessment and other reports, and Josh Zuber for his 2004 field assistance 'conquering' the slopes of the Smoky River. Also, we would like to acknowledge the expertise of Dr Shilong Mei, who kindly provided help in producing images for the project.