Linking base metal and barite mineralization in the Windsor-Kennetcook basin to the Kennetcook Thrust System

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(Department of Natural Resources before October, 2013)

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1. Windsor-Kennetcook Basin
   - Main Point
   - Context
2. Kennetcook Thrust System
   - Geometrical model
   - Structural control for barite/base metals

Walton Thurst (of the Kennetcook Thrust System)

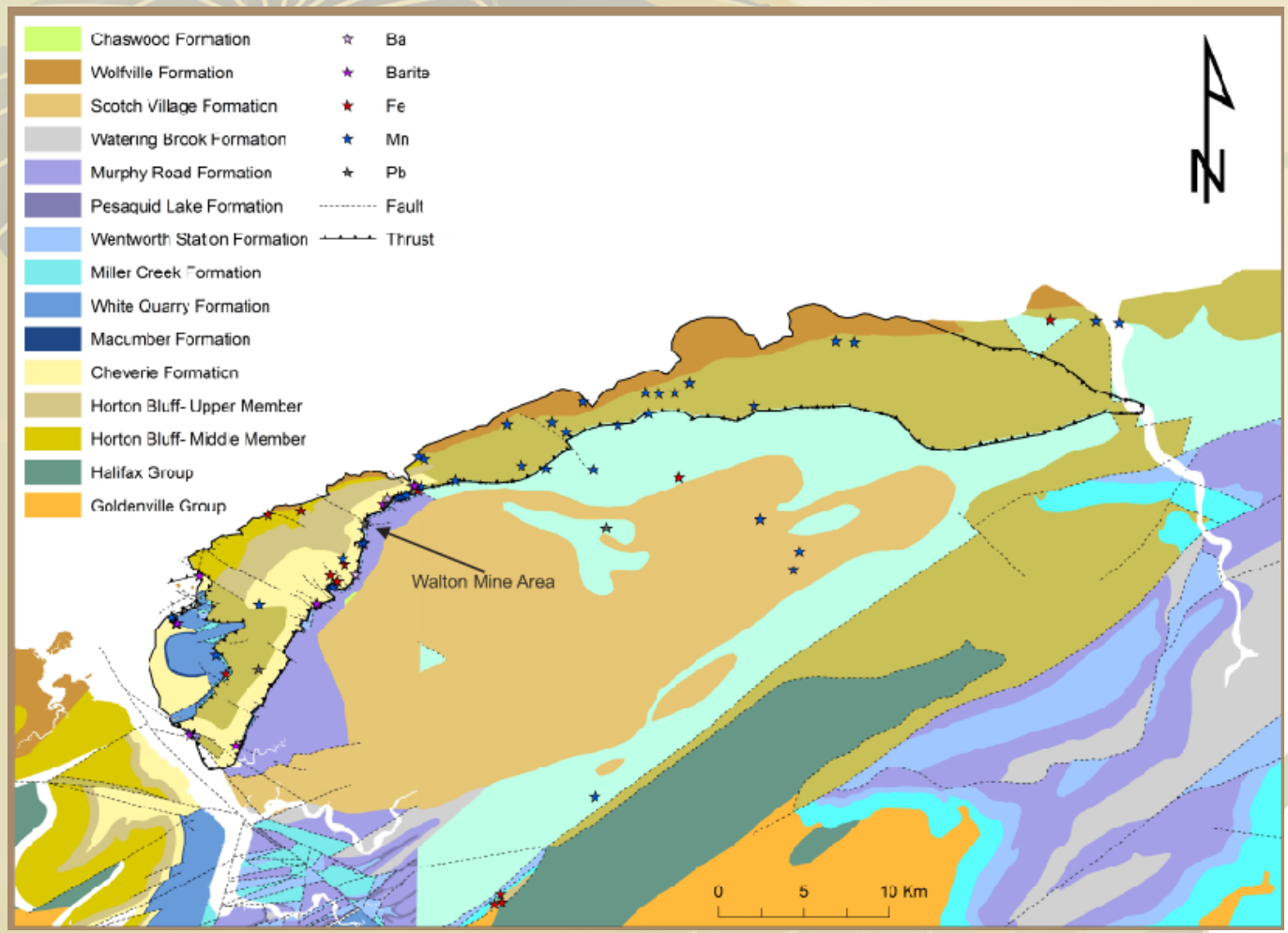


Figure: from Broughm & Keppie, 2013

Walton Thrust (possible link to barite/base metals)

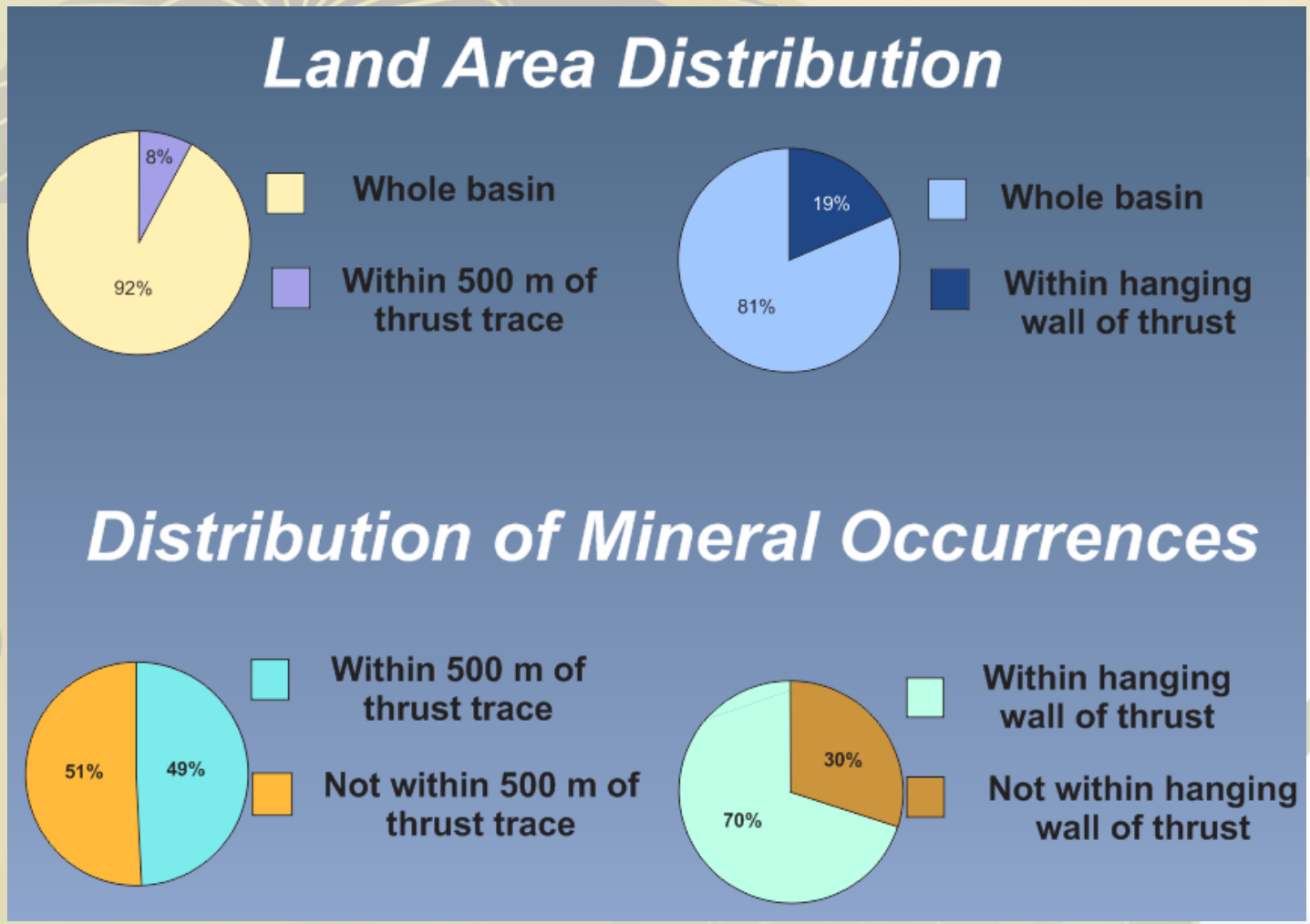
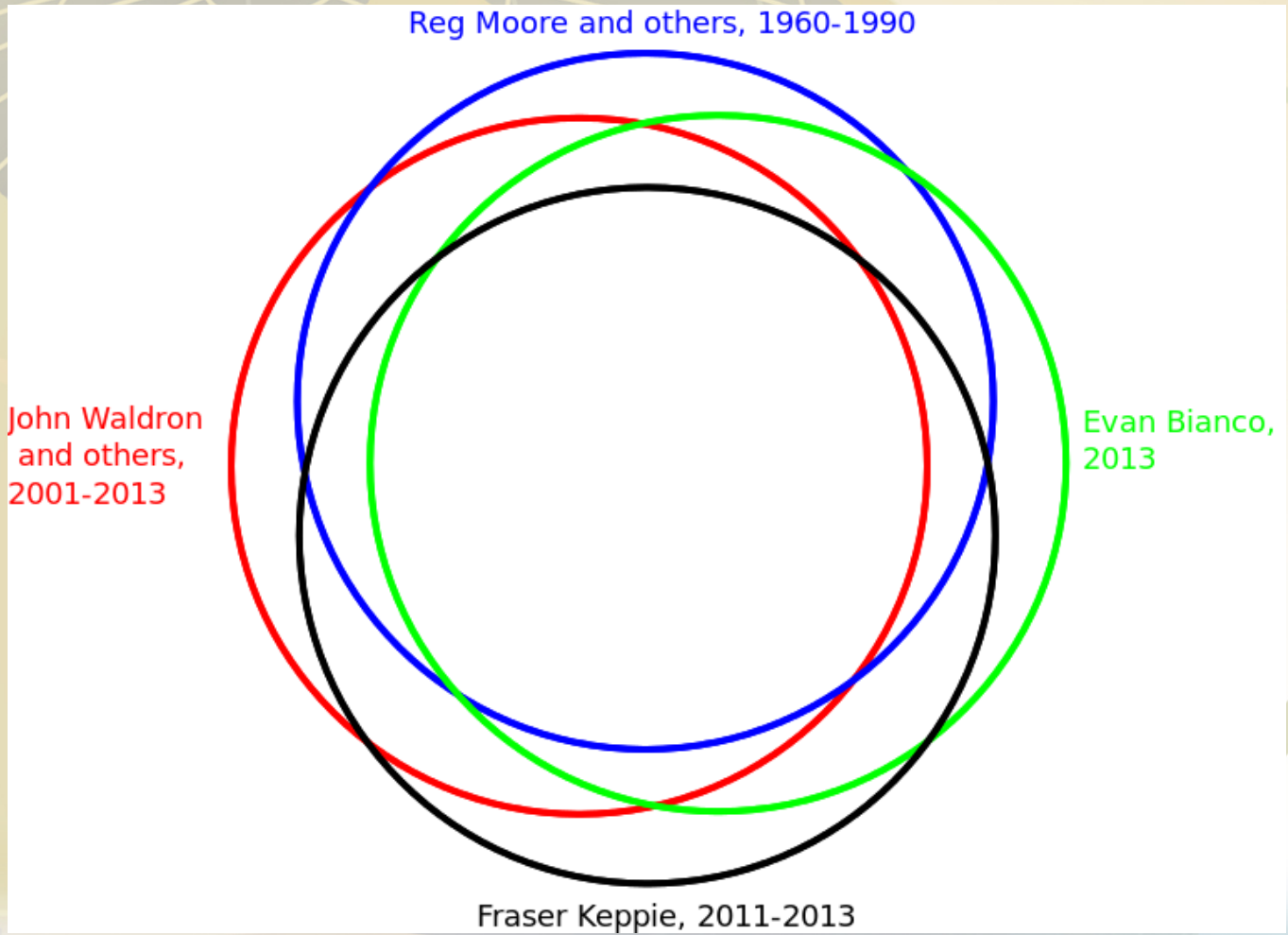
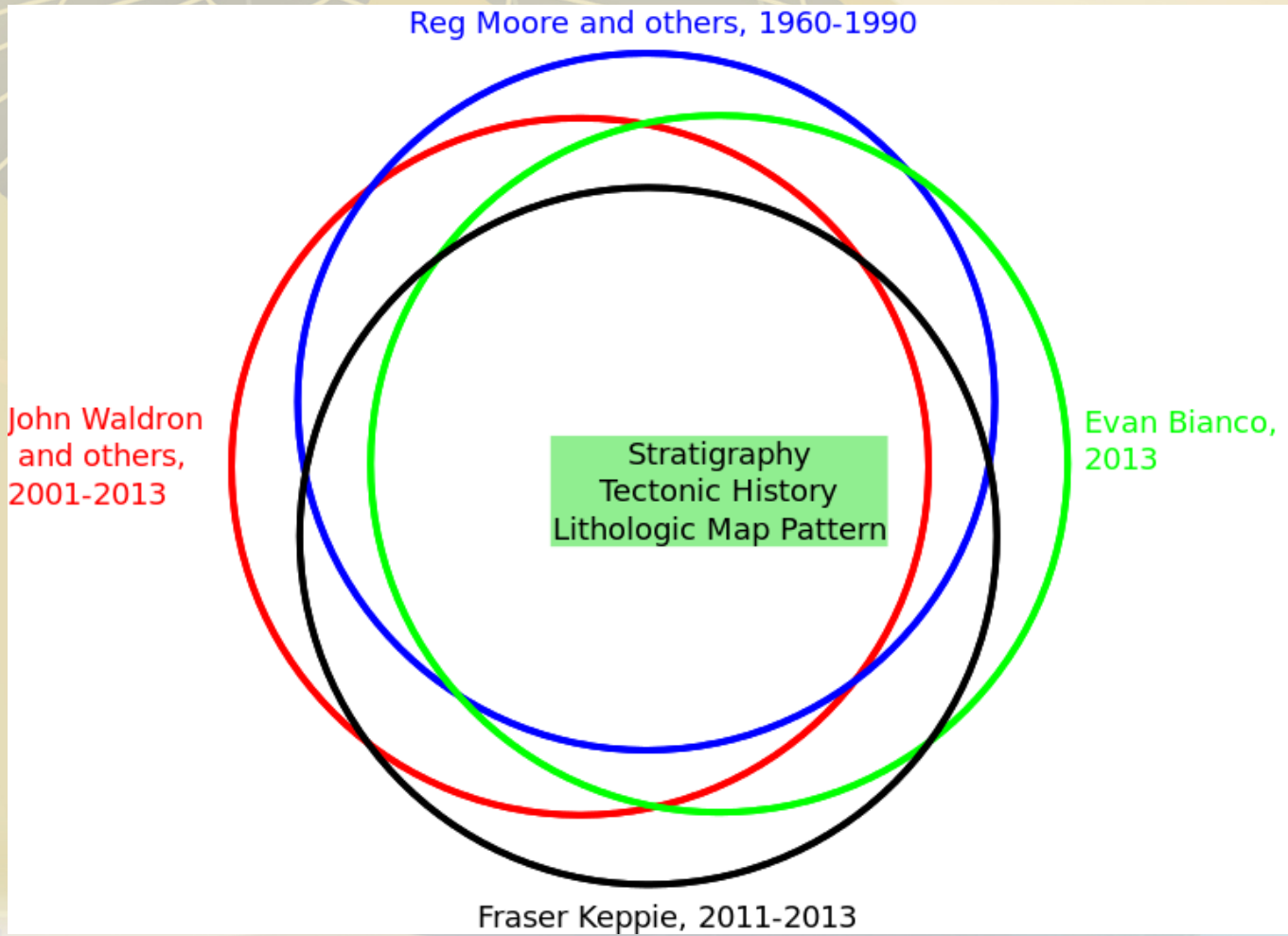


Figure: from Brough & Keppie, 2013

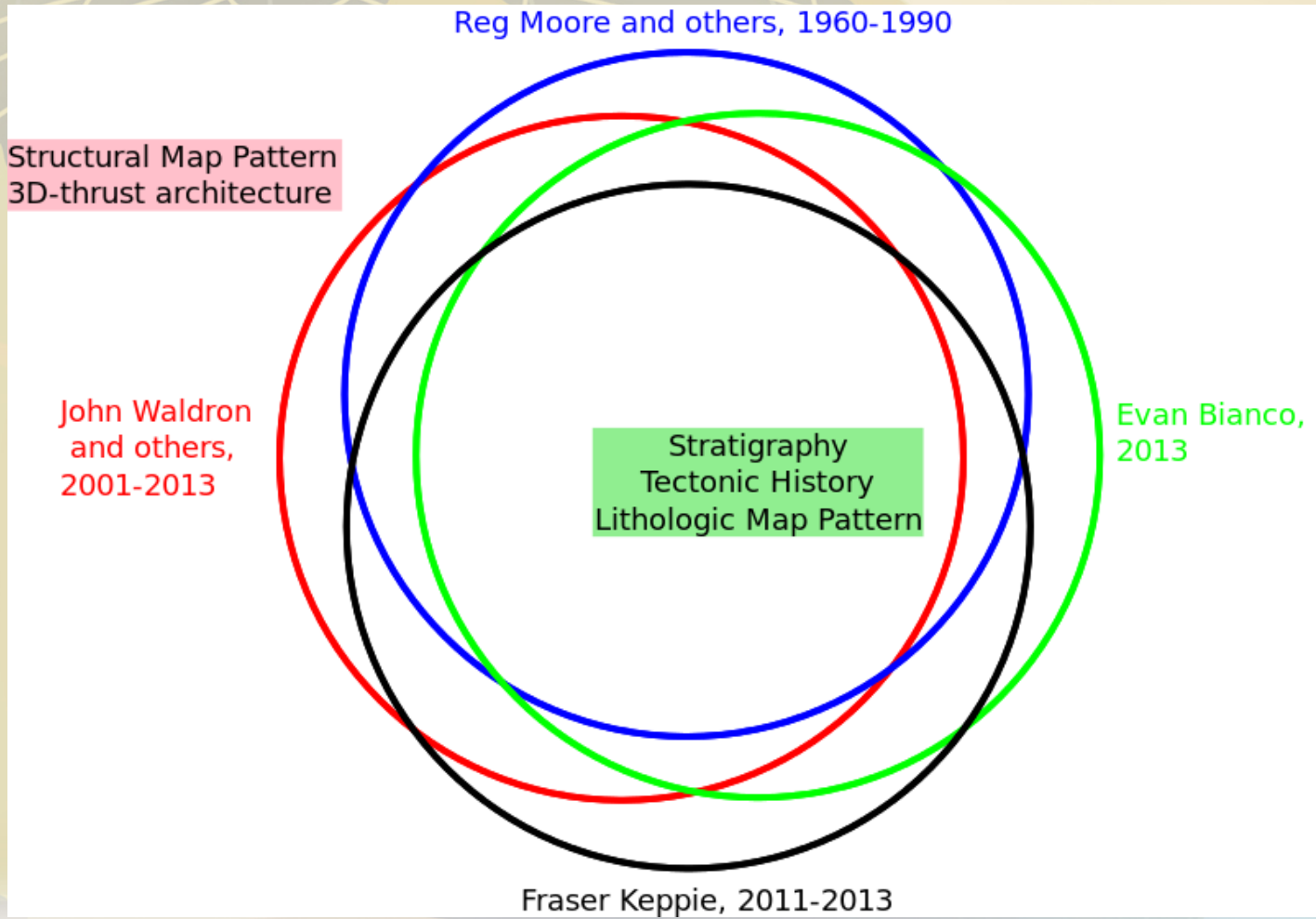
Multiple investigations: 4 views



Multiple investigations: Common elements



Multiple investigations: Contrasting elements



Exploration strategy: Stratigraphic control

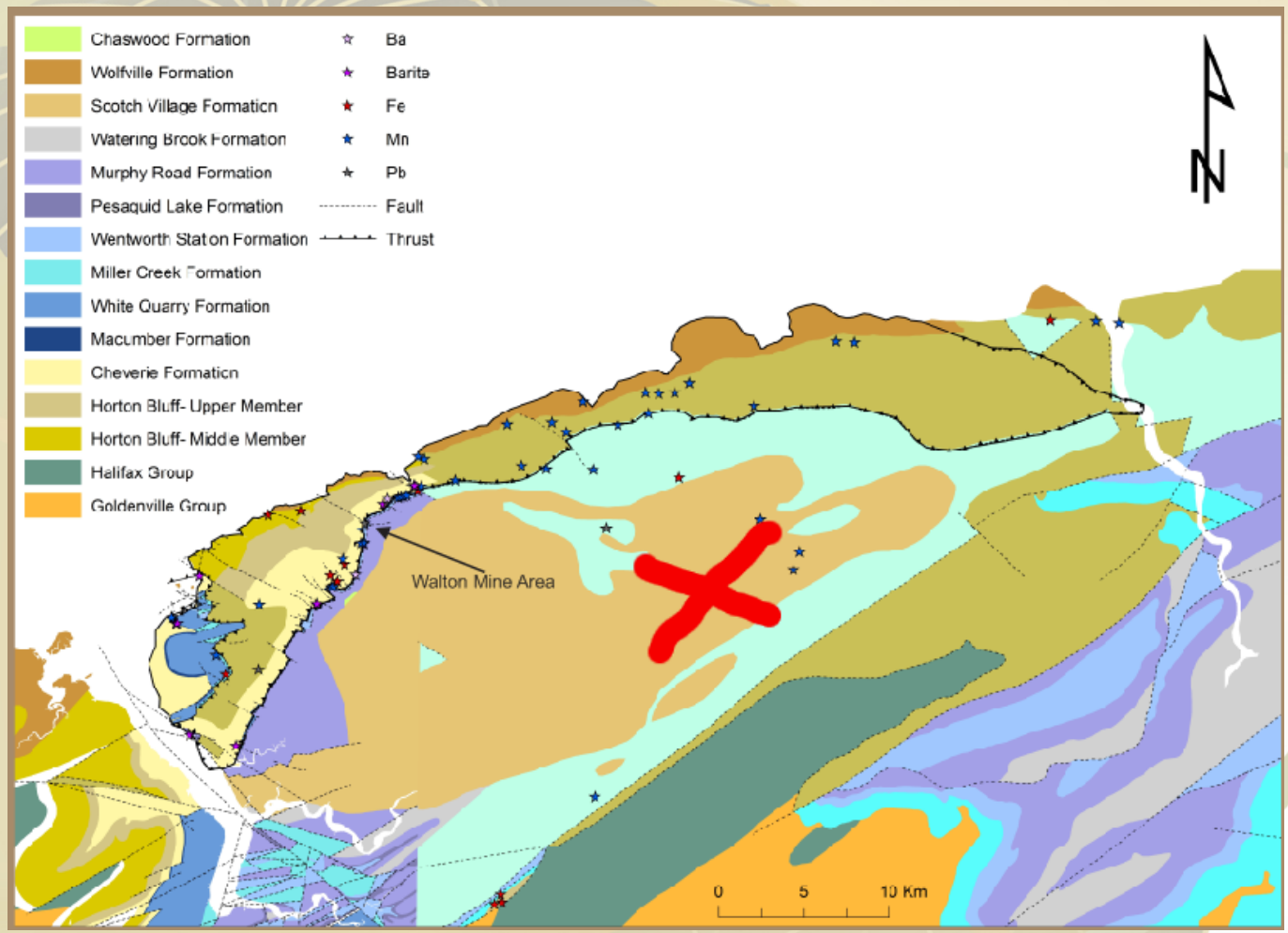


Figure: from Broughm & Keppie, 2013

Exploration strategy: Thrust control

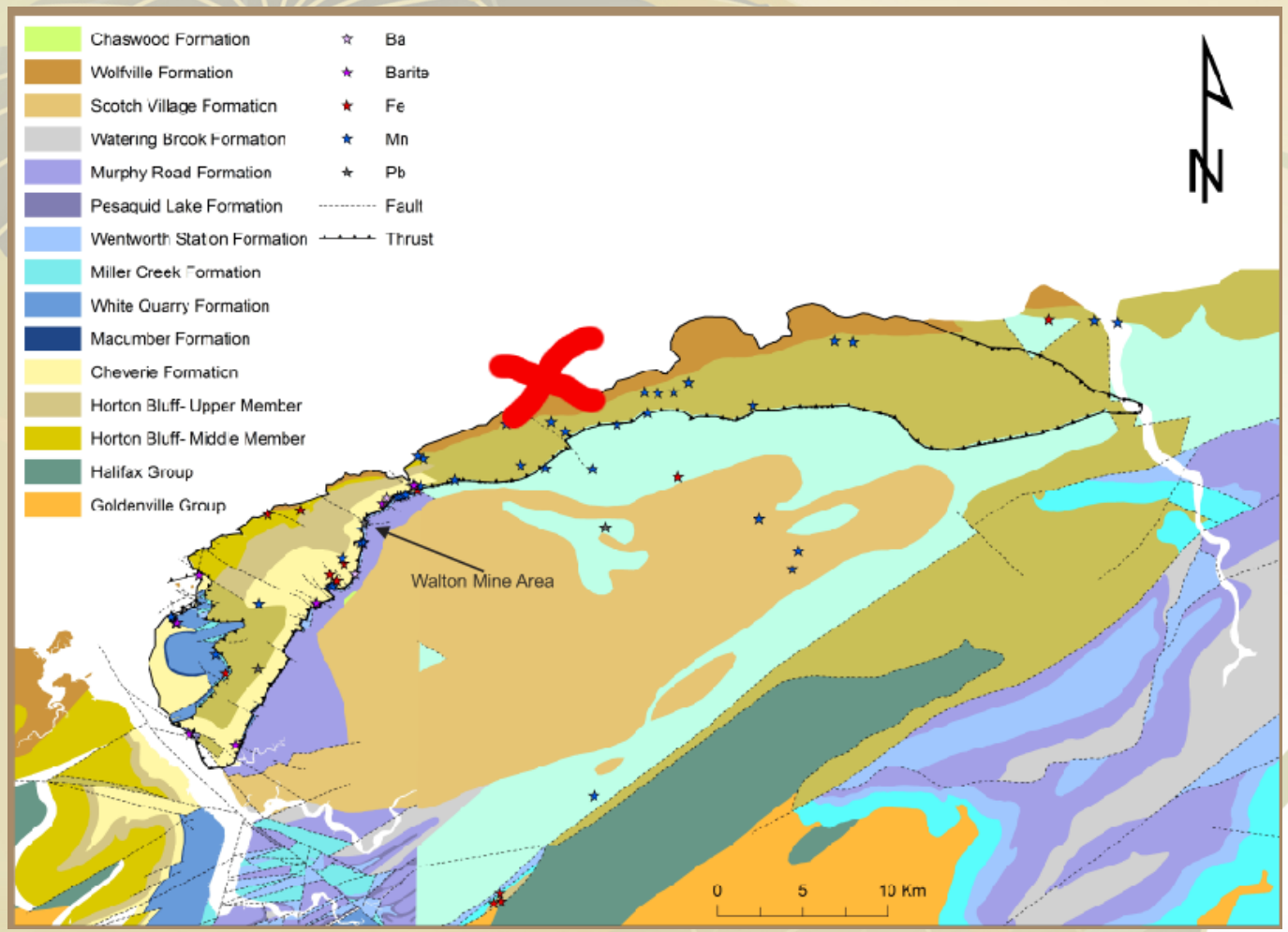


Figure: from Broughm & Keppie, 2013

The Maritimes Basin (& Windsor-Kennetcook sub-basin)

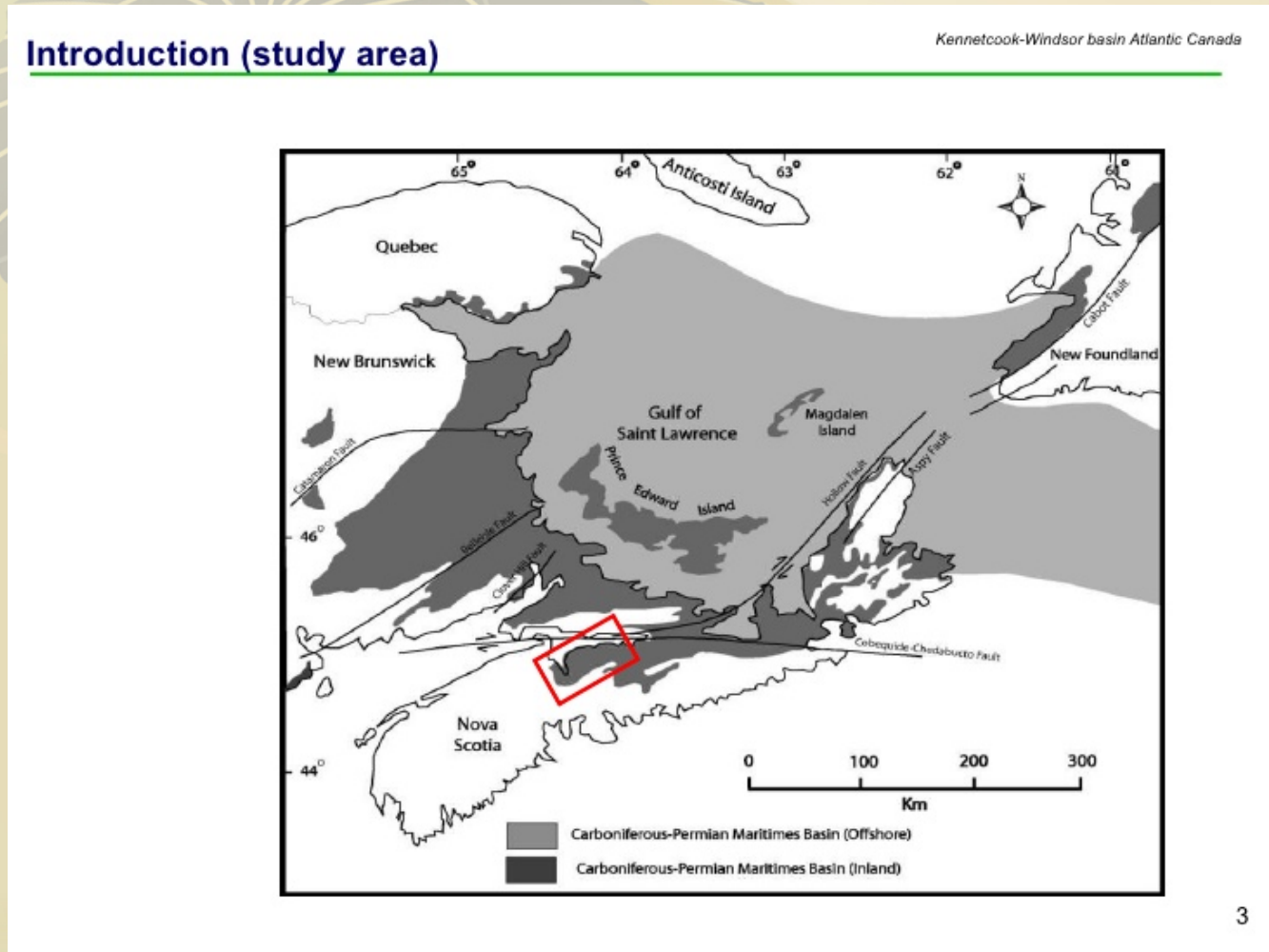


Figure: from Javaid, 2011

Appalachian context

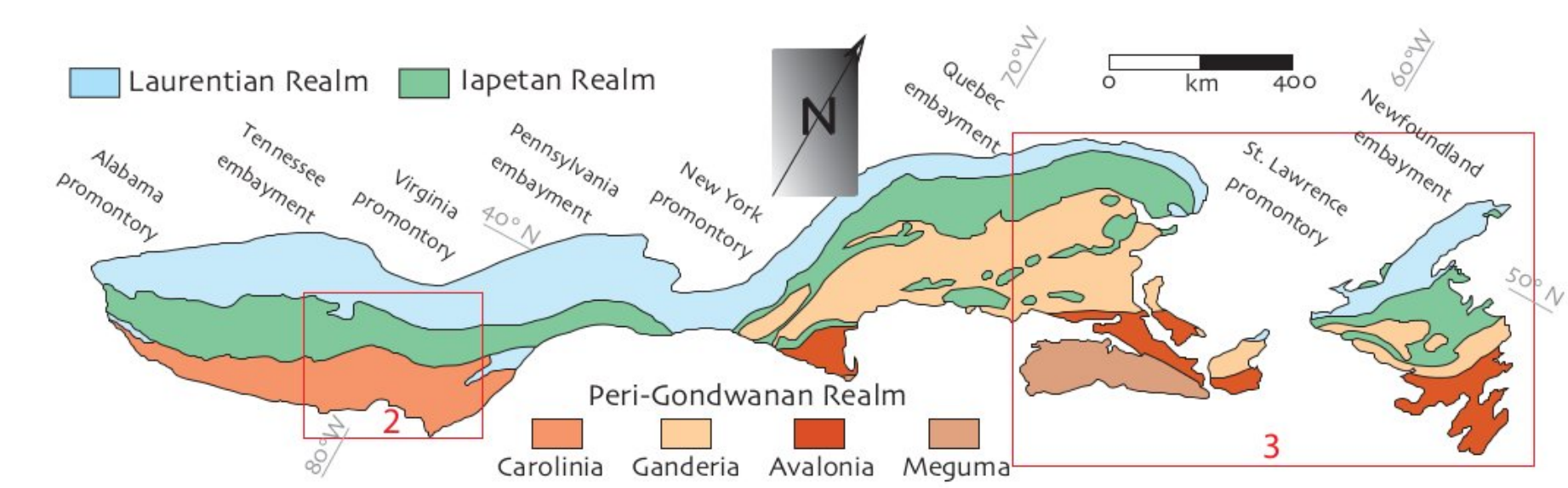


Figure: from Hibbard & Waldron, 2009

Tectonic setting for the Maritimes Basin?

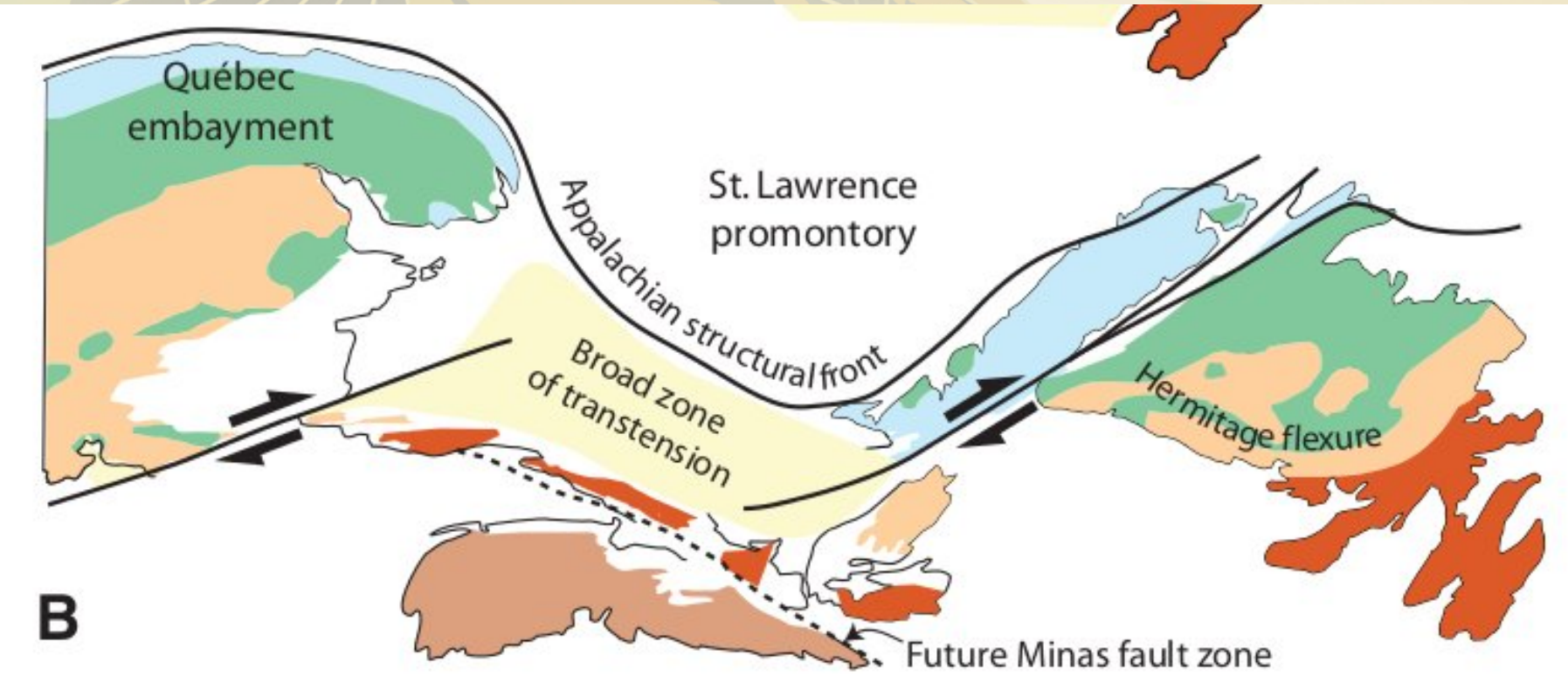


Figure: from Hibbard & Waldron, 2009

Tectonic setting for the Kennetcook Thrust System

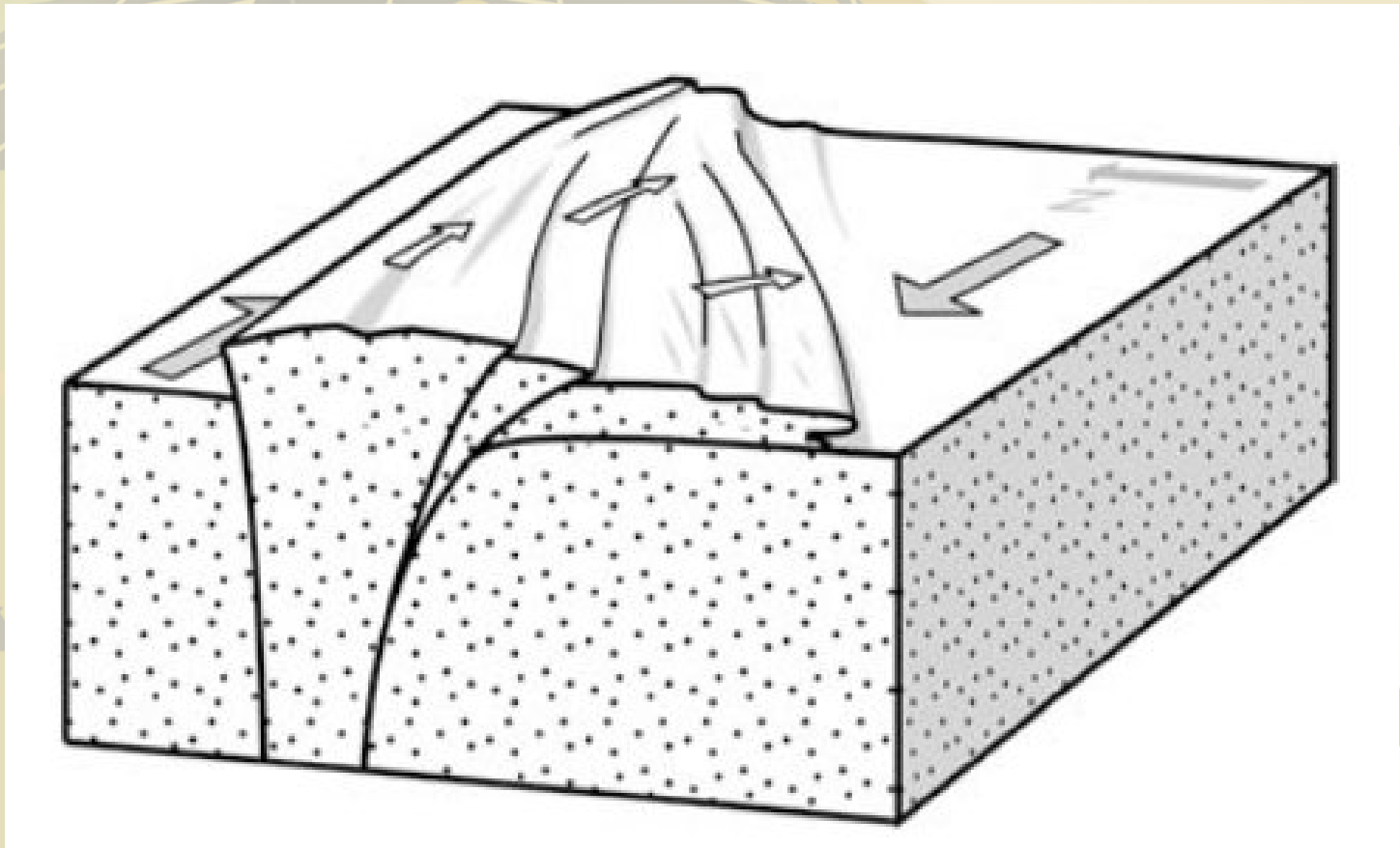


Figure: from Waldron et al., 2009

stratigraphic timing

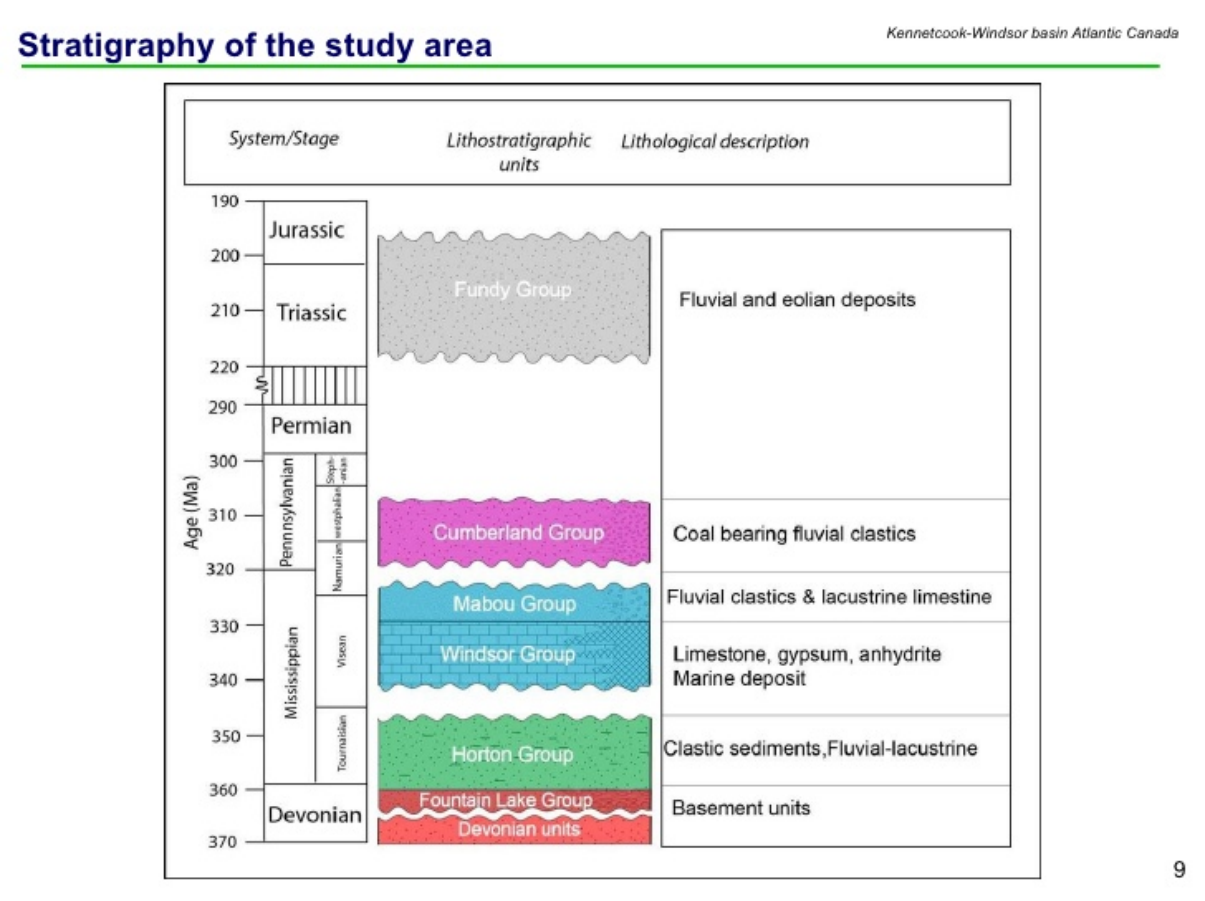


Figure: from Javaid, 2011

Kennetcook Thrust System timing

Age constraints for Kennetcook Thrust System

Deformed	Horton, Windsor, and Mabou (Waldron et al., 2007)
Not deformed	Scotch Village (Waldron et al., 2007)
Crosscutting	315 Ma igneous dykes (Kontak et al., 2000)
Age Bracket	325 Ma and 315 Ma (Waldron et al., 2007)

Carbonate-hosted barite/base metals timing

Age constraints for Carbonate-hosted mineralization

Fission tracks	zircon at Gays River	(Ravenhurst et al., 1989)
K-Ar	clays from proximal clastics	(Ravenhurst et al., 1989)
Rb-Sr	illite from distal sandstone	(Ravenhurst et al., 1989)
Pb isotopes	Horton Group source at 300 Ma	(Ravenhurst et al., 1989)
Age Bracket	330 Ma to 300 Ma	(Ravenhurst et al., 1989)

NOVA SCOTIA

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Other constraints for Carbonate-hosted mineralization

Source	basin-derived fluids (Ravenhurst et al., 1989)
Temperature	230 to 130 Celsius (Ravenhurst et al., 1989)

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zircon fission track ages

TABLE 3. Zircon Fission-Track Dates

Sample no.	Location (no. in Fig. 2)	Number of grains	Fossil tracks $\times 10^5/cm^2$	Induced tracks $\times 10^5/cm^2$	Dosimeter tracks $\times 10^5/cm^2$	Chi-square	Age (Ma)[1] $\pm 1\sigma$
RGR-161	1. Gays River	3	79.5 (609)	9.40 (72)	2.00	0.6	308 ± 37
RGR-162	1. Gays River	14	55.6 (2,121)	6.66 (254)	2.08	12.0	315 ± 21
RGR-165	1. Gays River	11	58.6 (1,063)	6.46 (117)	2.08	11.7	342 ± 33
RSB-48	2. Southvale	5	47.5 (408)	6.87 (59)	2.10	2.5	265 ± 36
RSB-21	5. Smithfield	10	54.1 (1,276)	9.41 (222)	2.07	7.4	217 ± 16
RSB-22a	5. Smithfield	16	47.0 (1,498)	6.40 (204)	2.00	11.0	268 ± 20
RSB-22b	5. Smithfield	11	54.2 (1,431)	7.50 (198)	2.09	8.0	275 ± 21
RSB-5/24	7. Brookfield	2	51.7 (202)	8.96 (35)	2.09	0.1	221 ± 40

Figure: from Ravenhurst et al., 1989

Timing for structural control model

Thrusts provide a spatial control for barite and base metals?

Basin age	360 to 290 Ma	(Keppie, 2000)
Thrust age	325 Ma to 315 Ma	(Waldron et al., 2007)
Fluid age	330 Ma to 300 Ma	(Ravenhurst et al., 1989)

Walton Thurst (of the Kennetcook Thrust System)

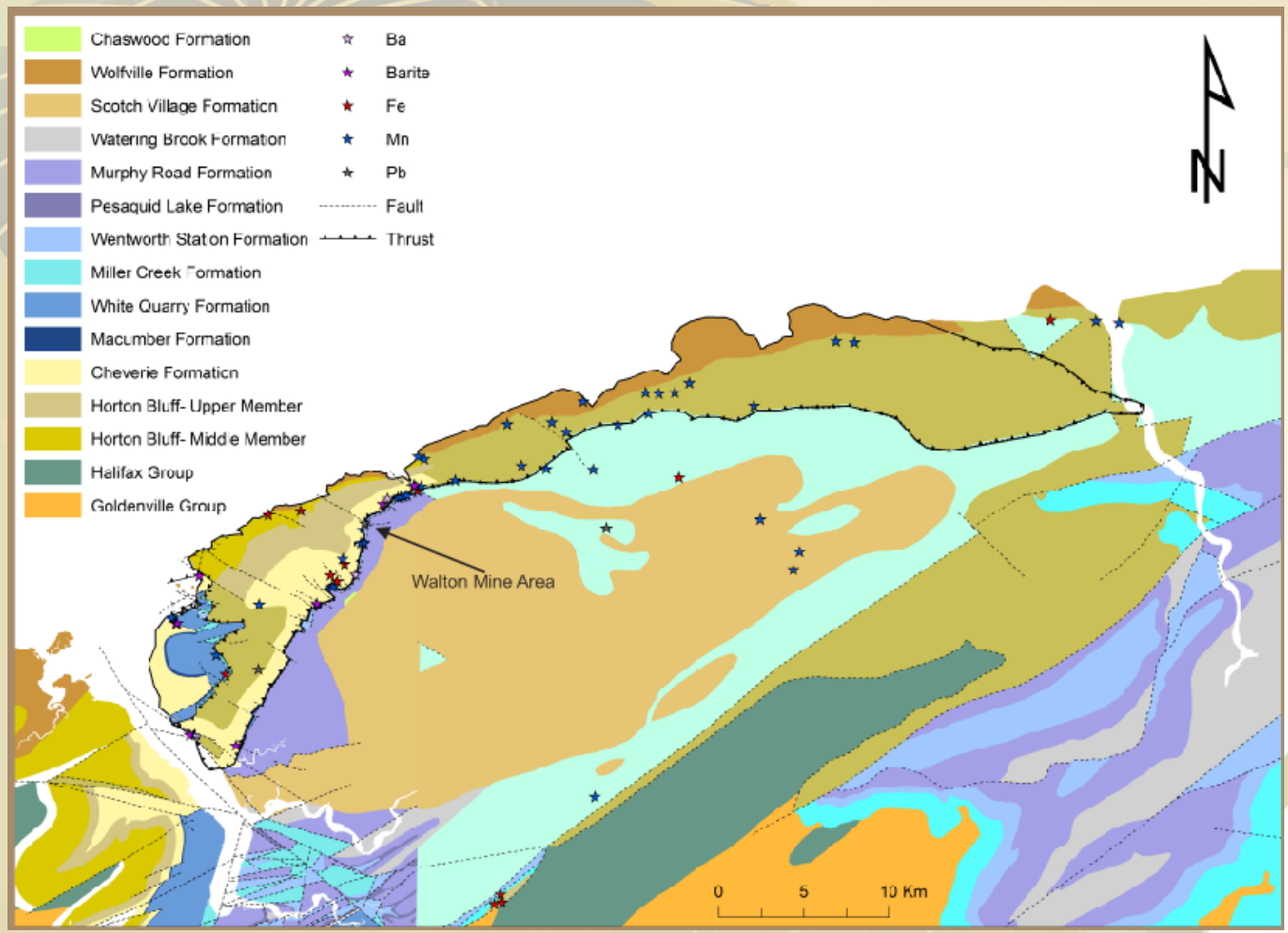

Figure: from Broughm & Keppie, 2013

Public seismic data

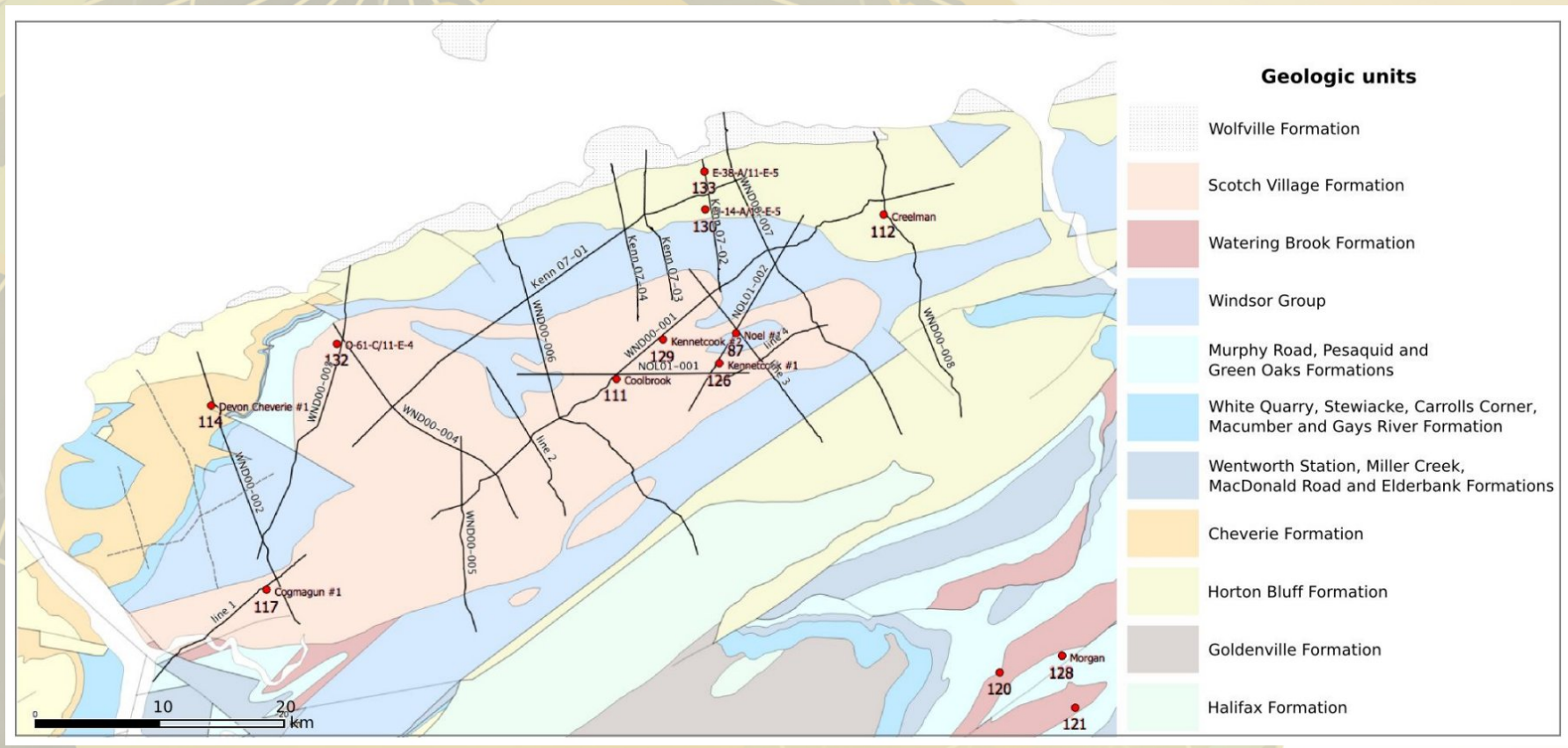

Figure: from Javaid, 2011

Poly-phase fault history

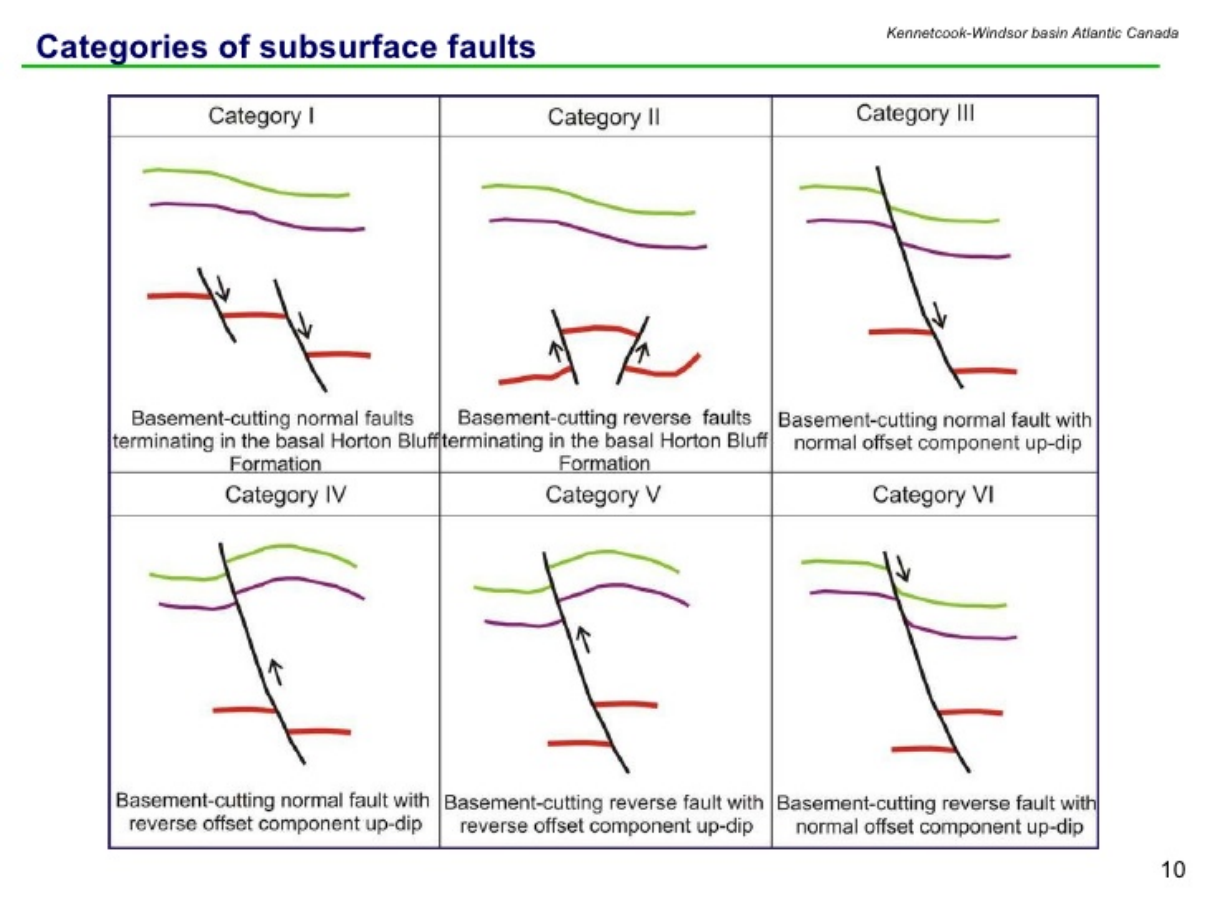

Figure: from Javaid, 2011

Interpretation 1 of Wind-07

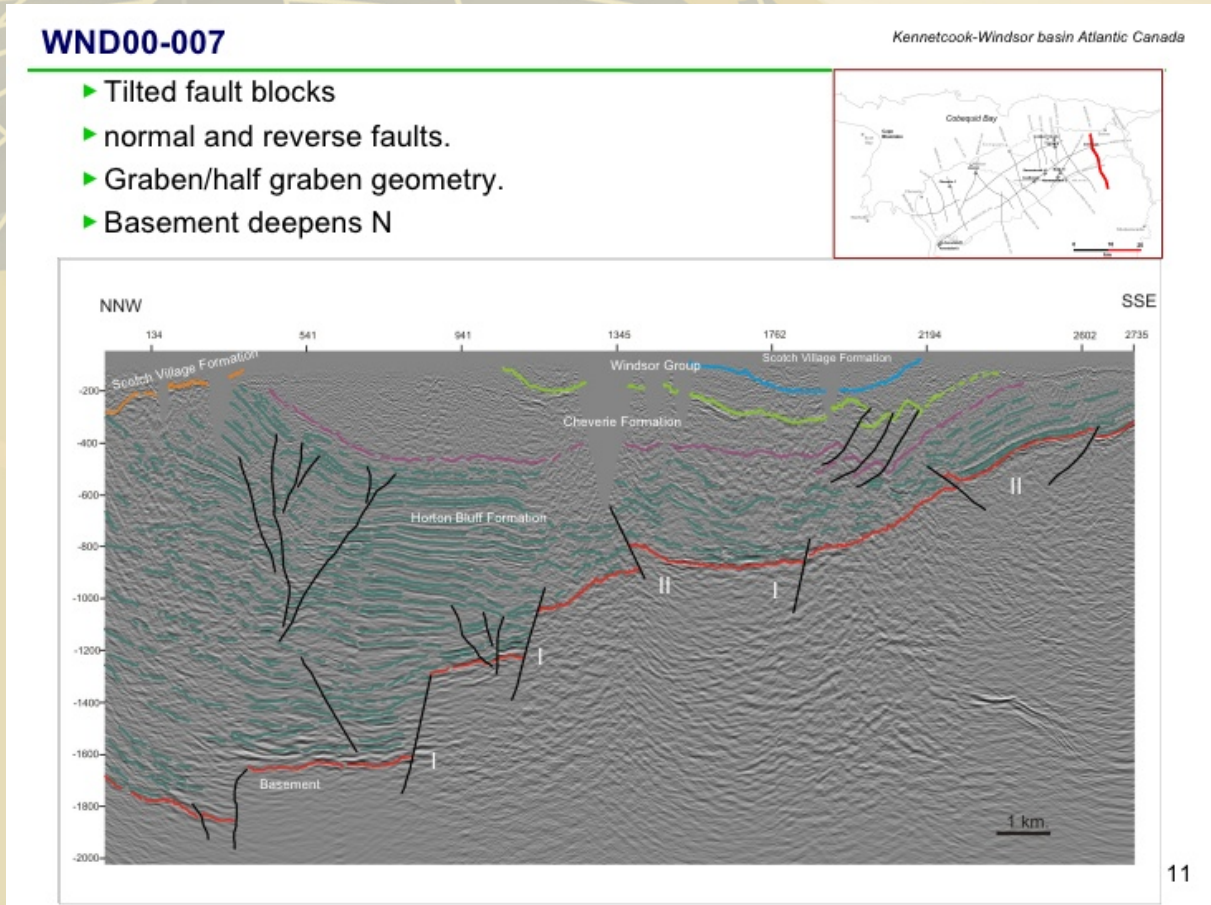

Figure: from Javaid, 2011

Interpretation 2 of Wind-07

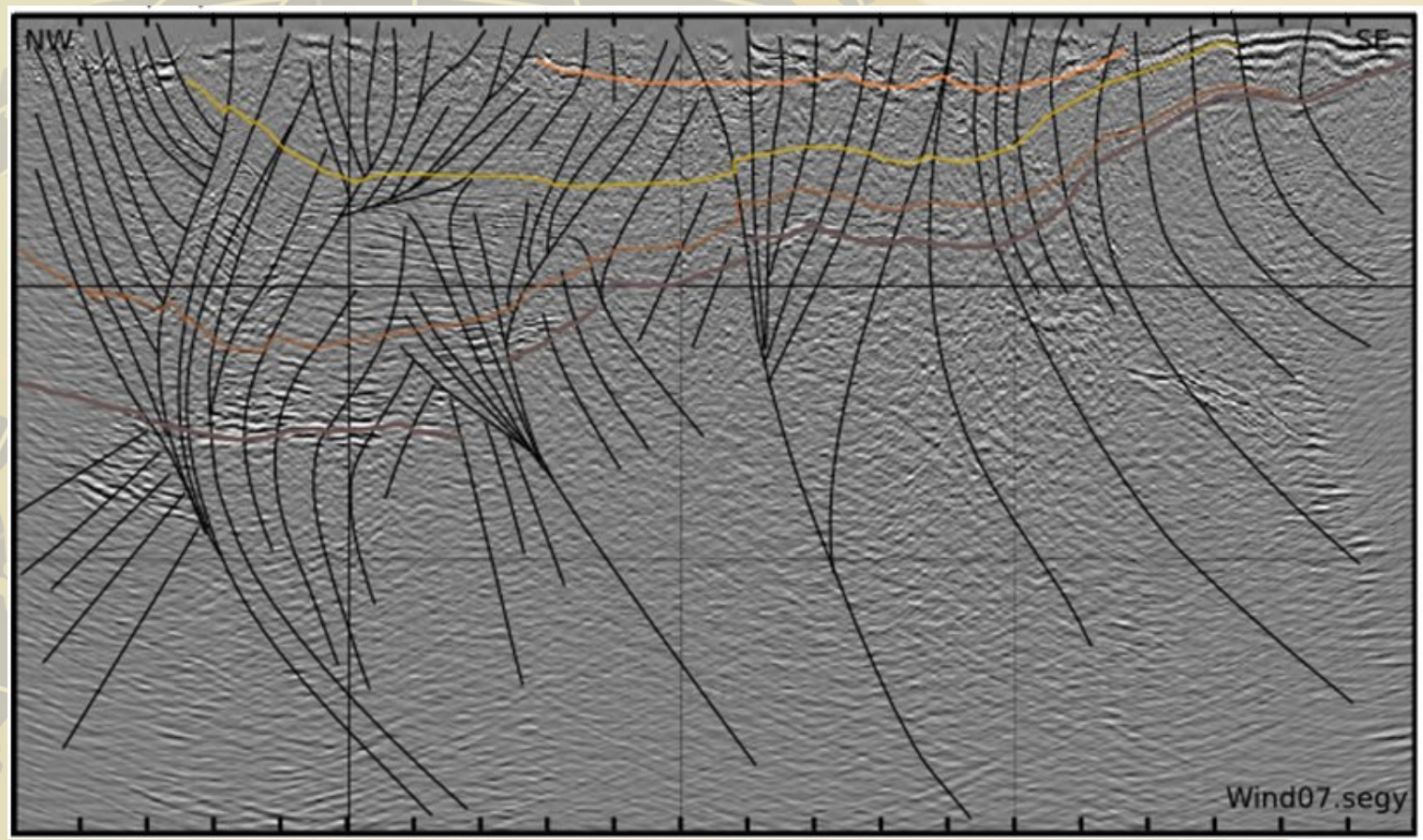

Figure: from Bianco, 2013

Interpretation 2 of Wind-07

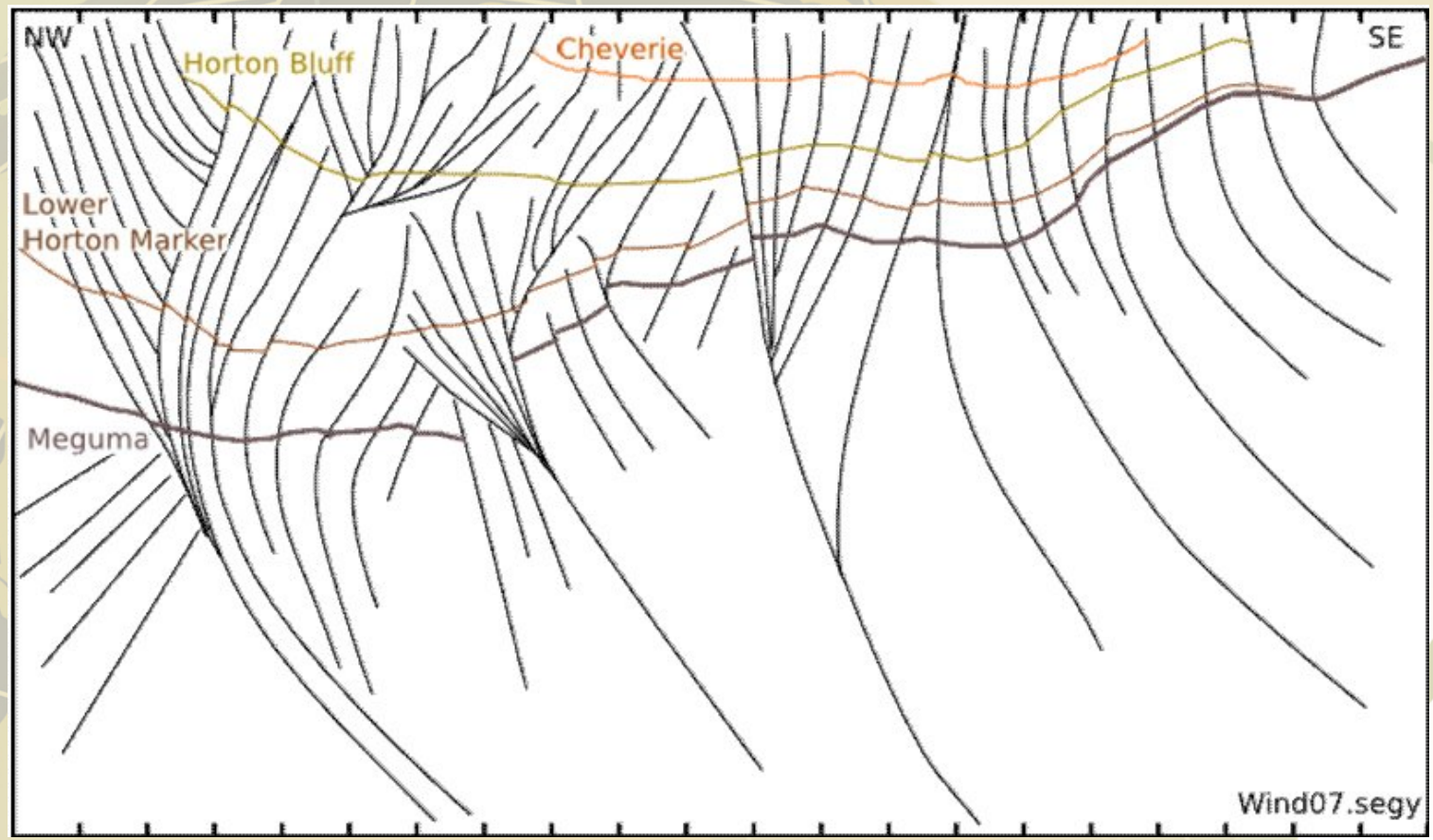

Figure: from Bianco, 2013

Cheverie No. 1

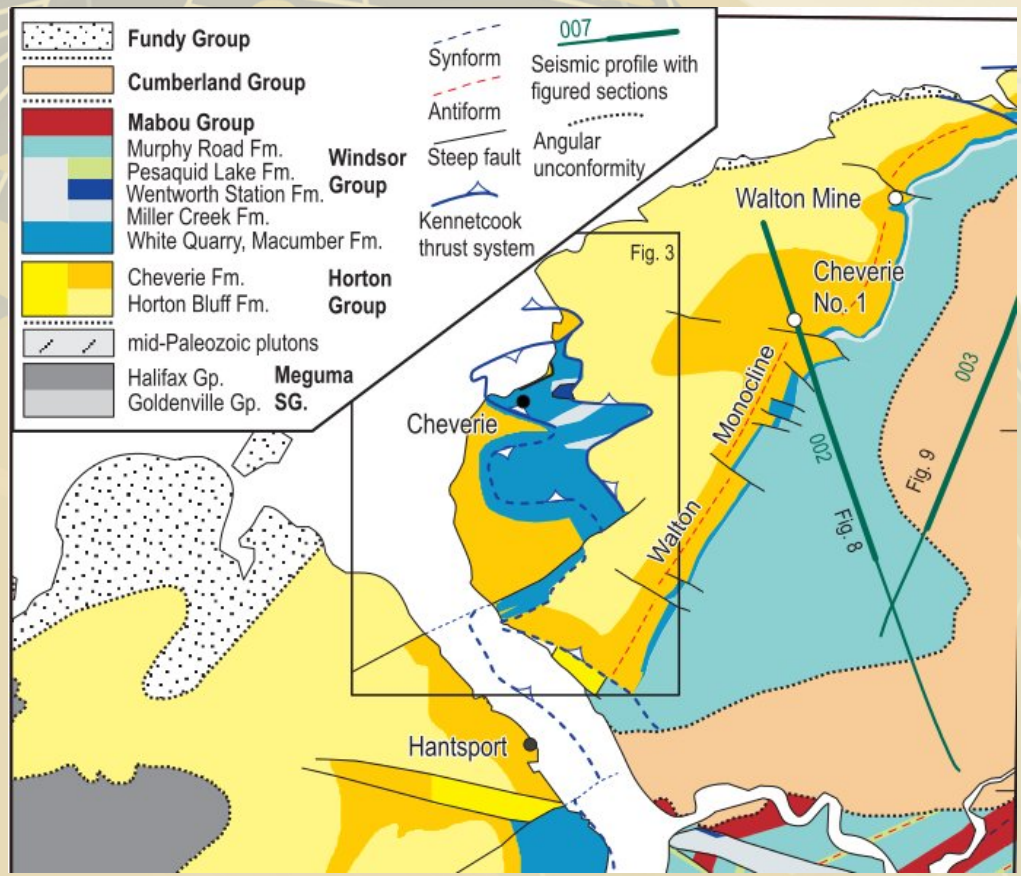

Figure: from Waldron et al., 2010

Cheverie No. 1

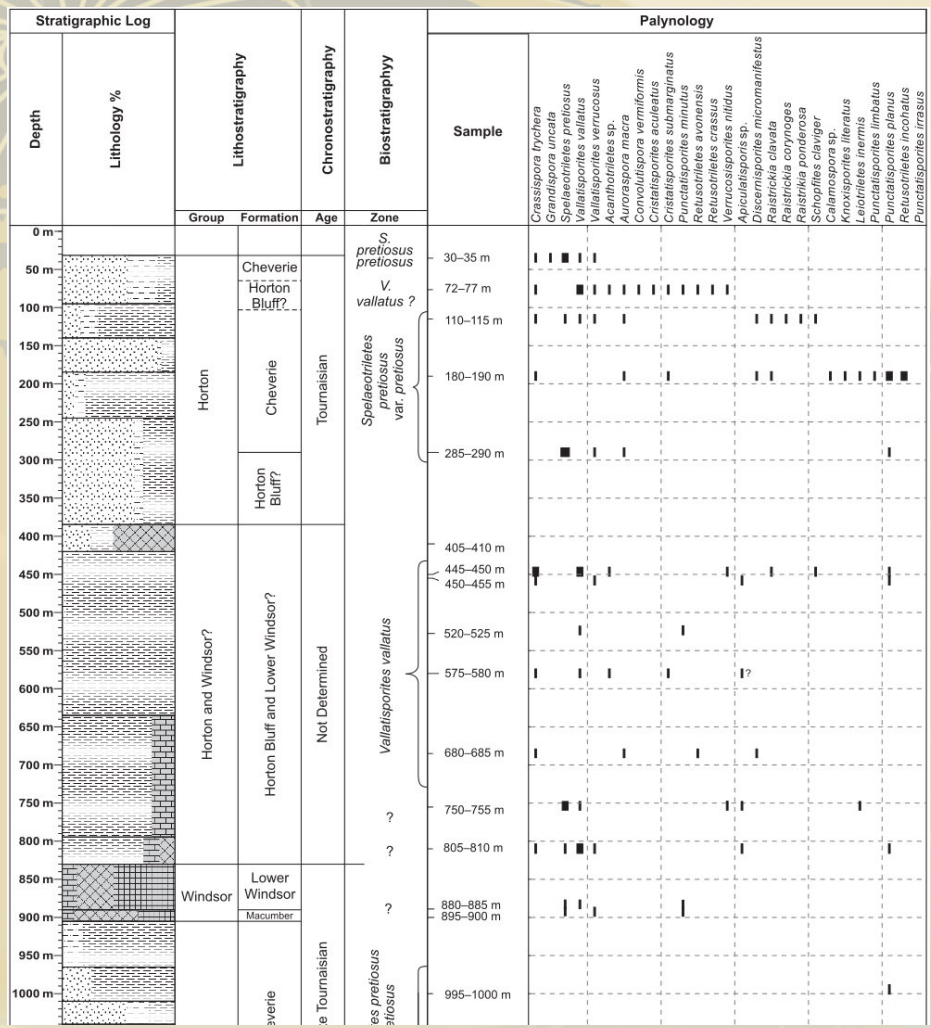

Figure: from Waldron et al., 2010

Interpretation 1 of Wind-02

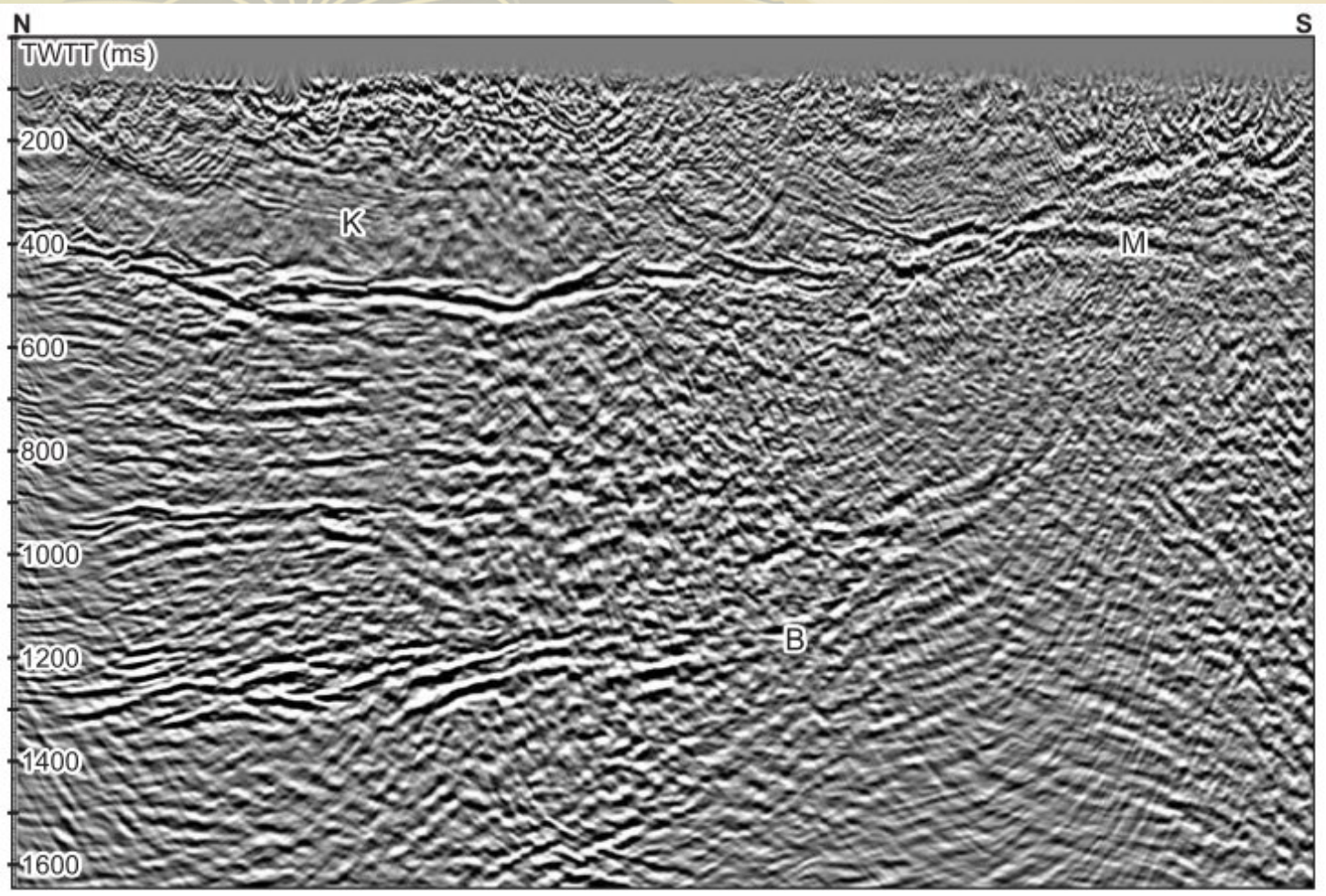

Figure: from Waldron et al., 2010

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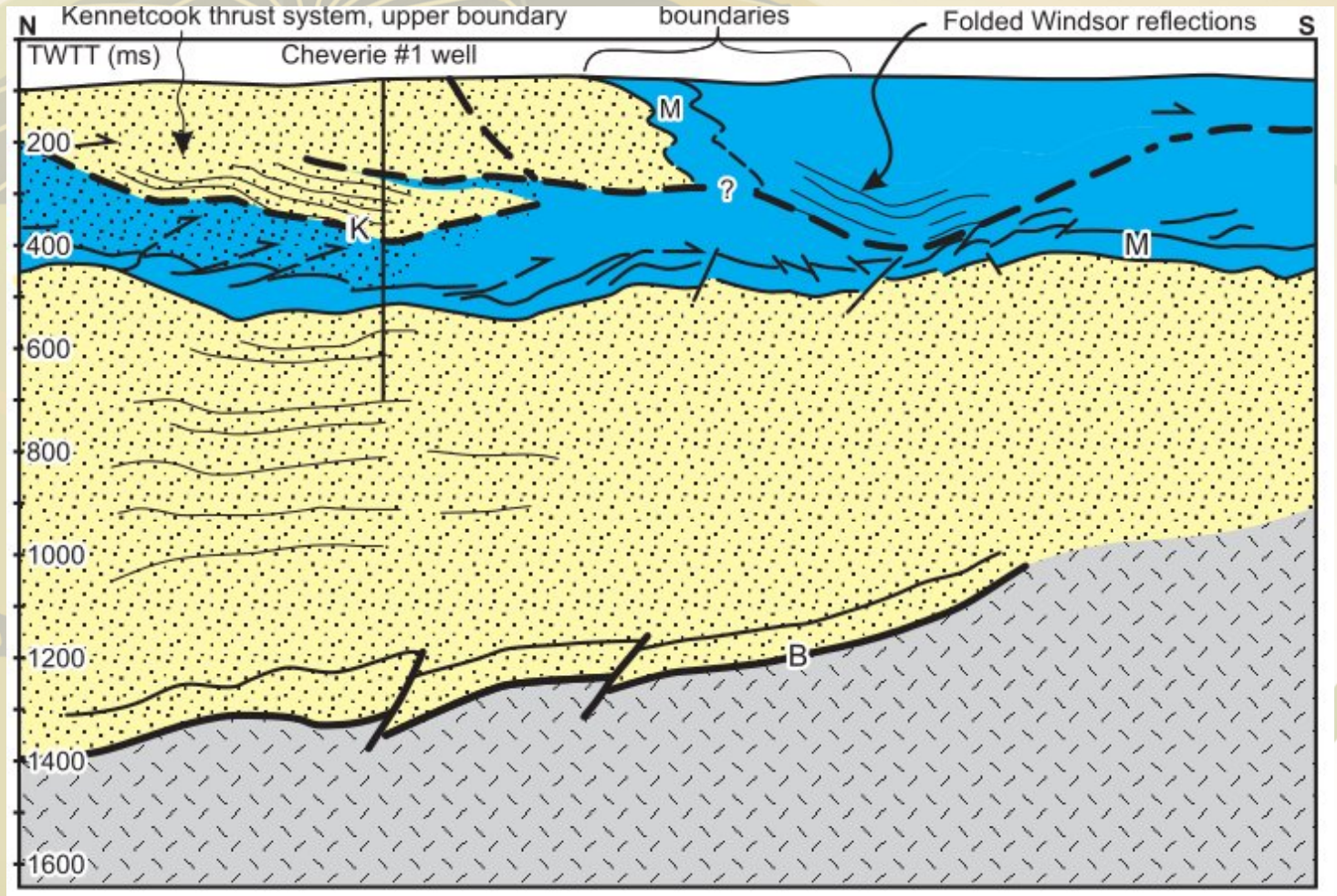


Figure: from Waldron et al., 2010

Interpretation 1 of Wind-03

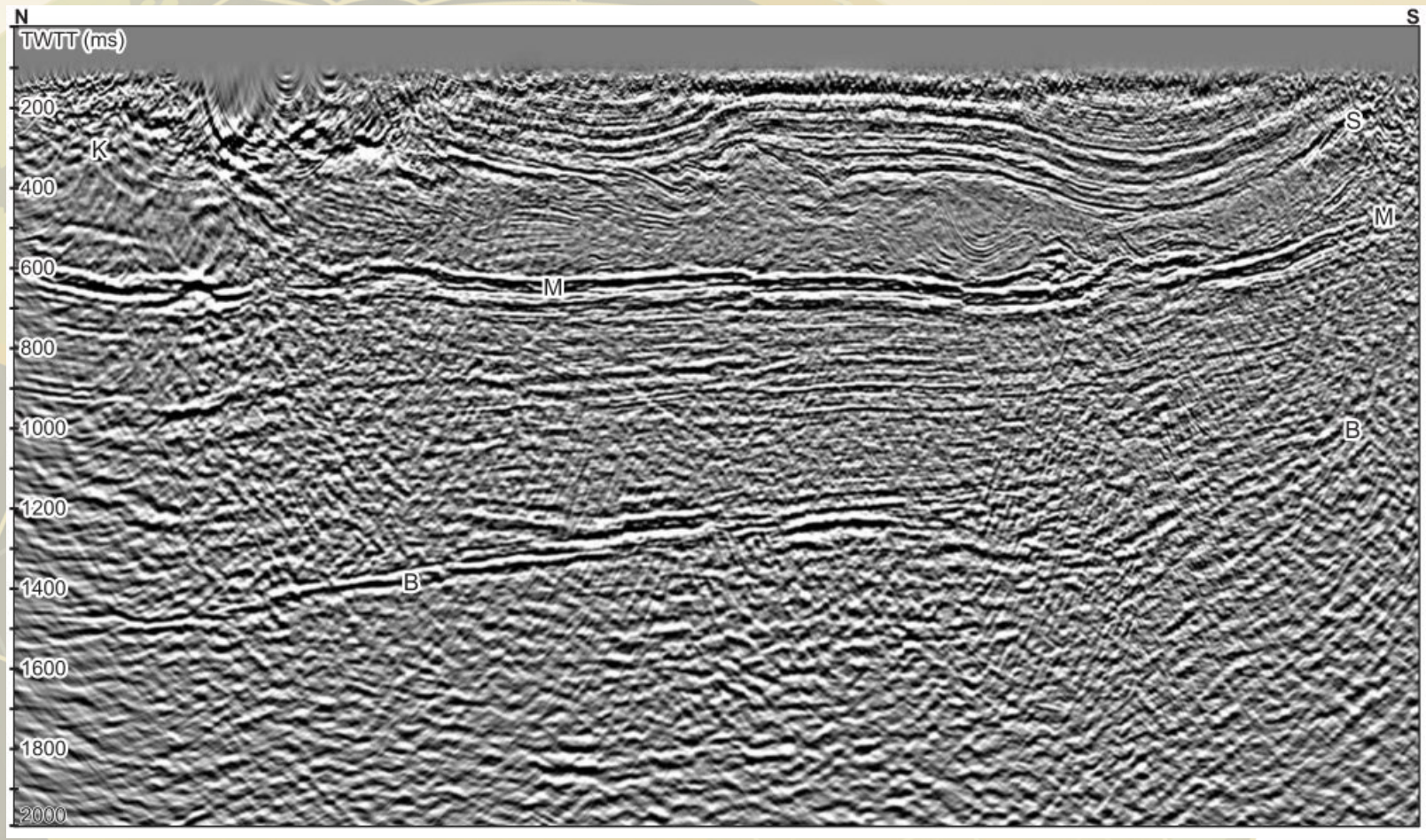


Figure: from Waldron et al., 2010

Interpretation 1 of Wind-03

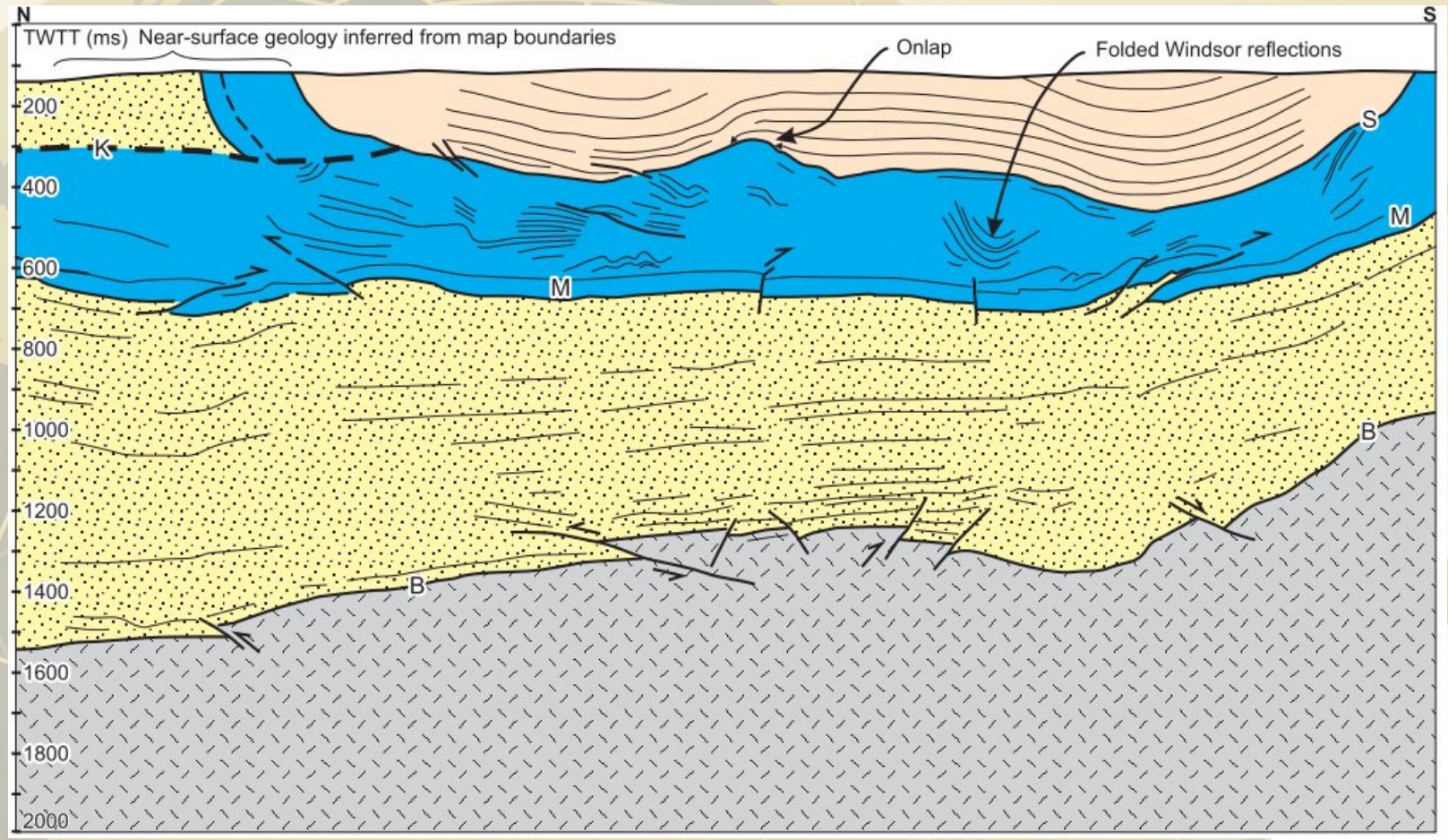
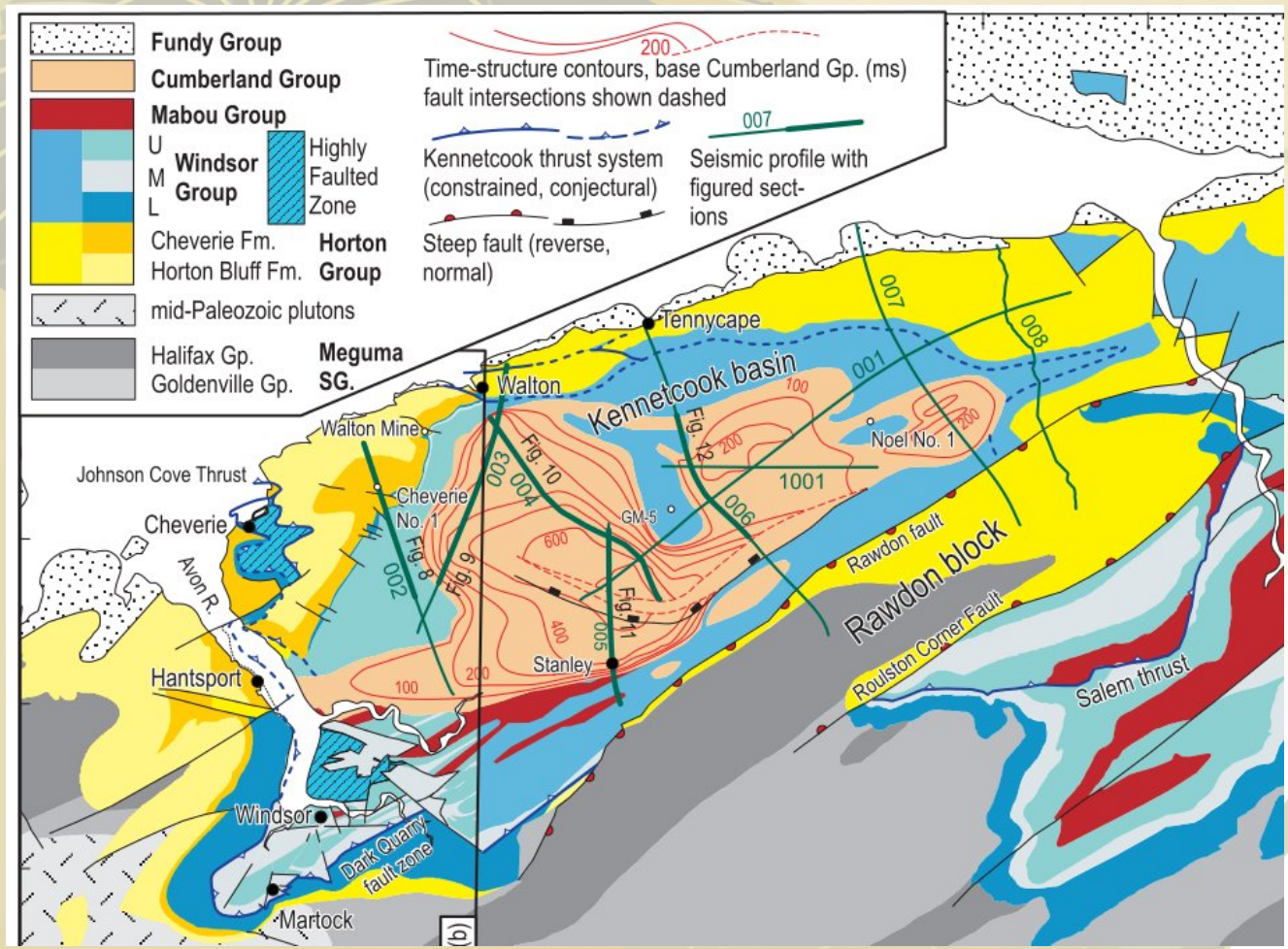


Figure: from Waldron et al., 2010

Kennetcook Thrust System?



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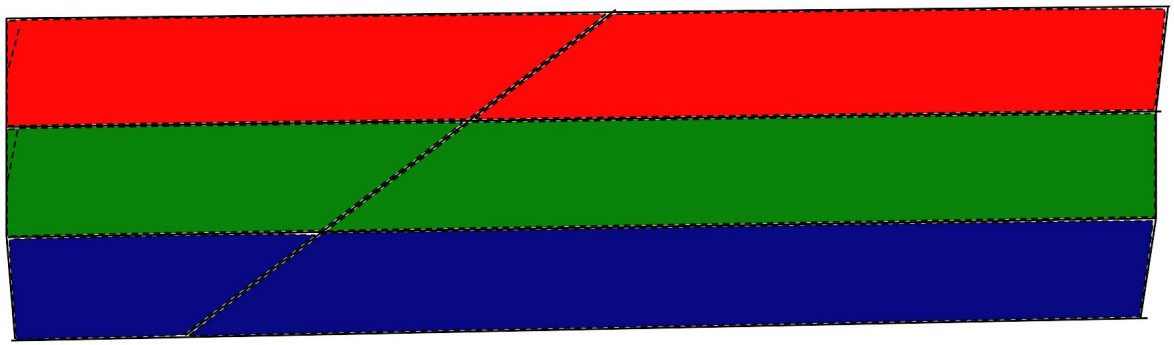
Kennetcook Thrust System?



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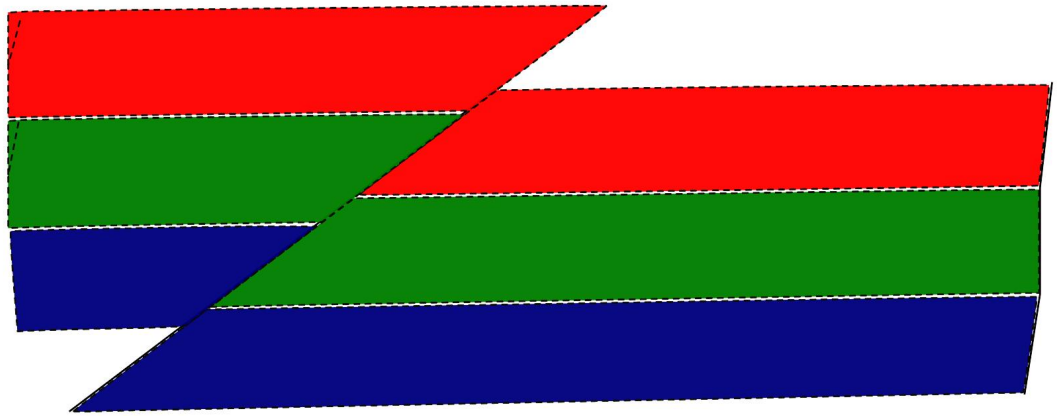

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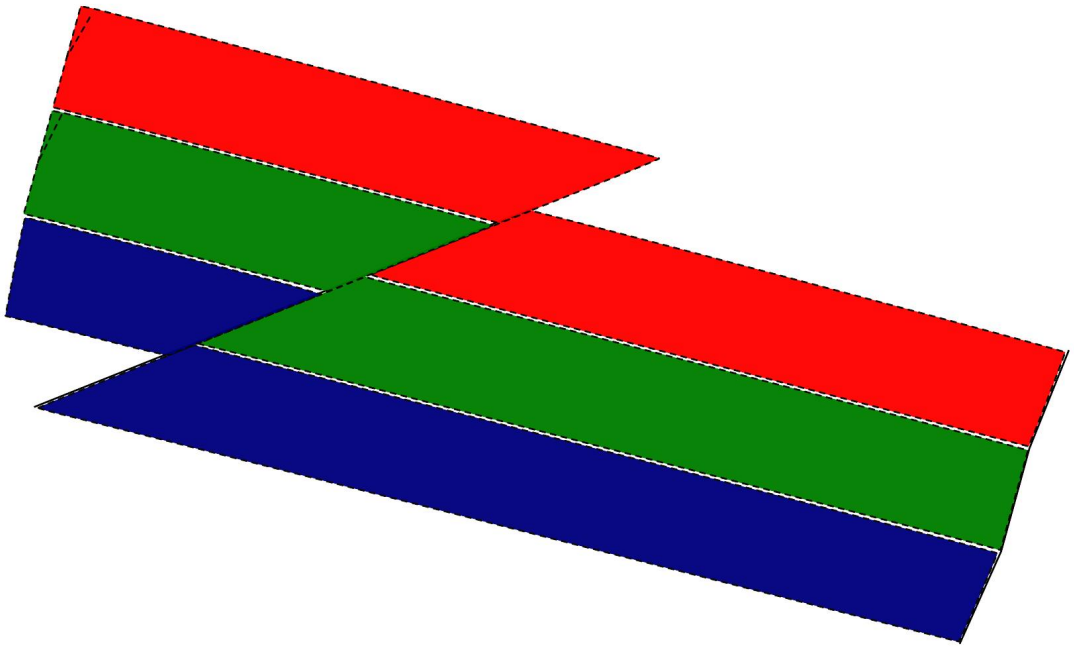

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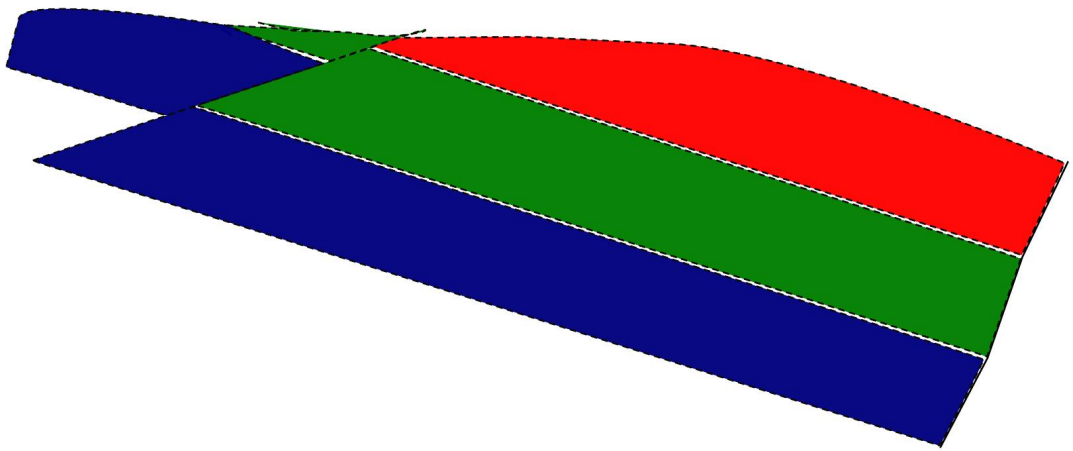

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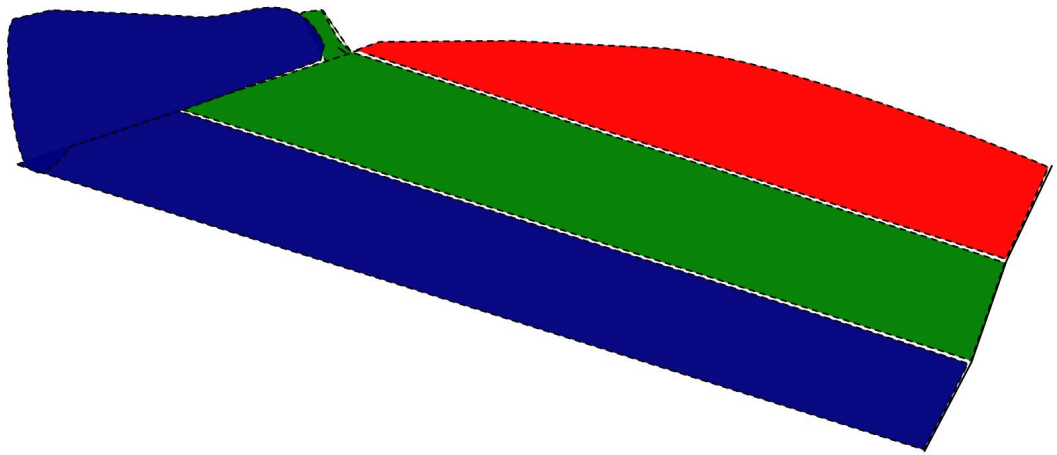

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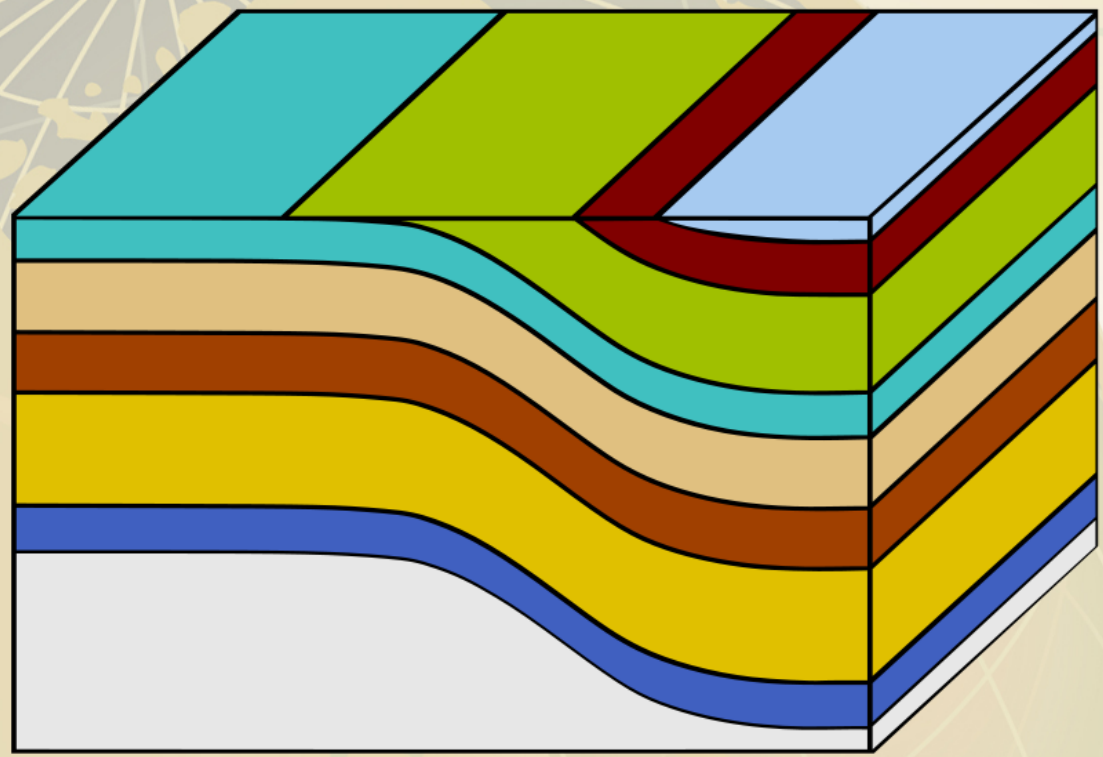

Figure: from Wikipedia, 2013

Kennetcook Thrust System?

Evidence for daylight to the southeast?

Stratigraphy Missing section

Structure Drag Fold = Monocline

Kennetcook Thrust System?

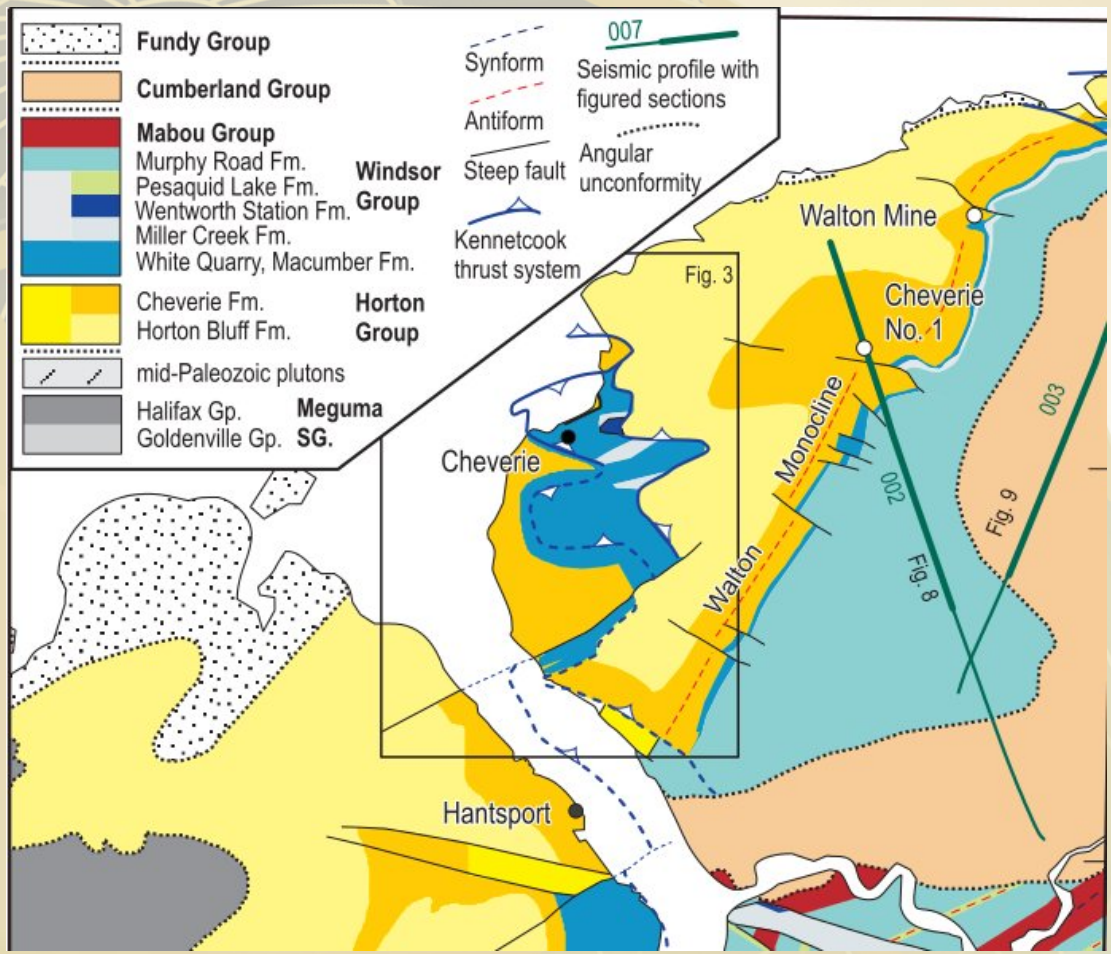

Figure: from Waldron et al., 2010

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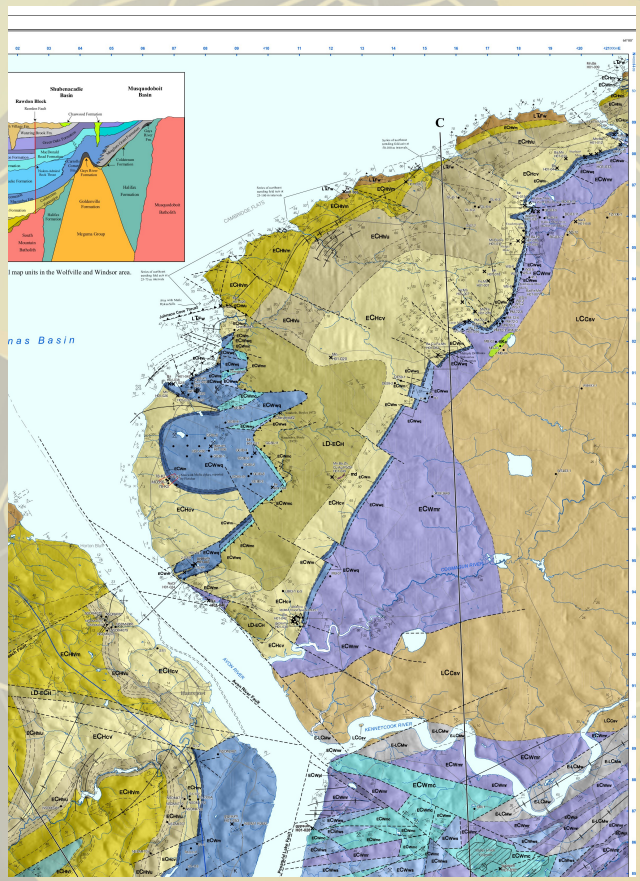
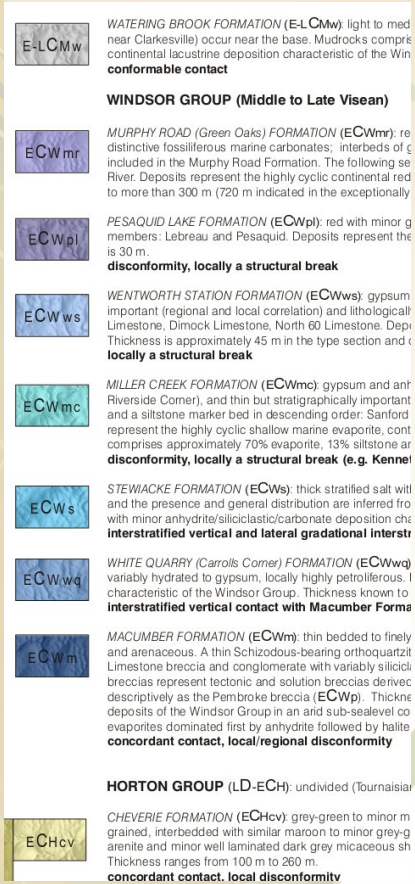


Figure: from Moore et al., 2000



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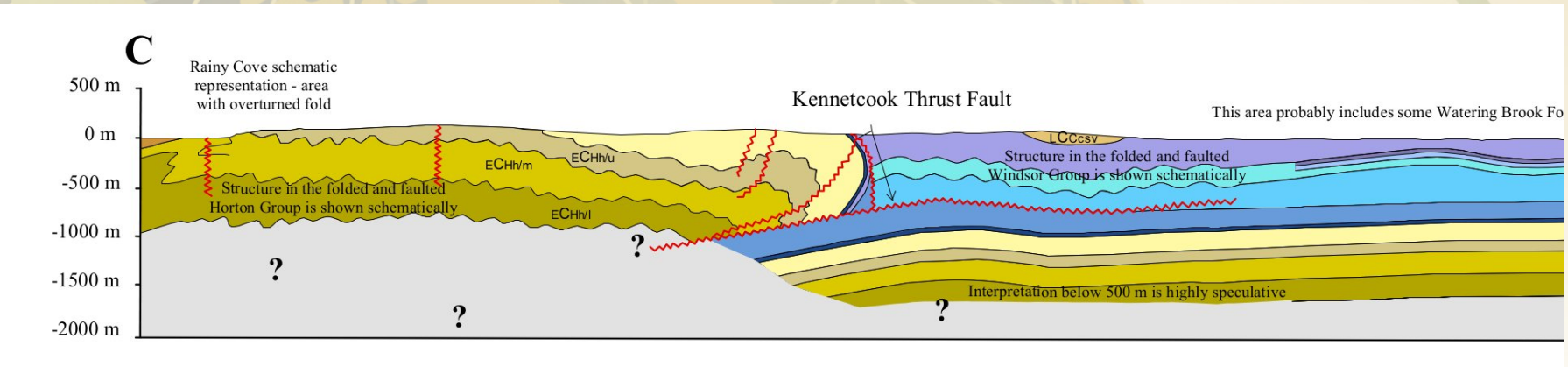

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Interpretation 2 of Wind-02

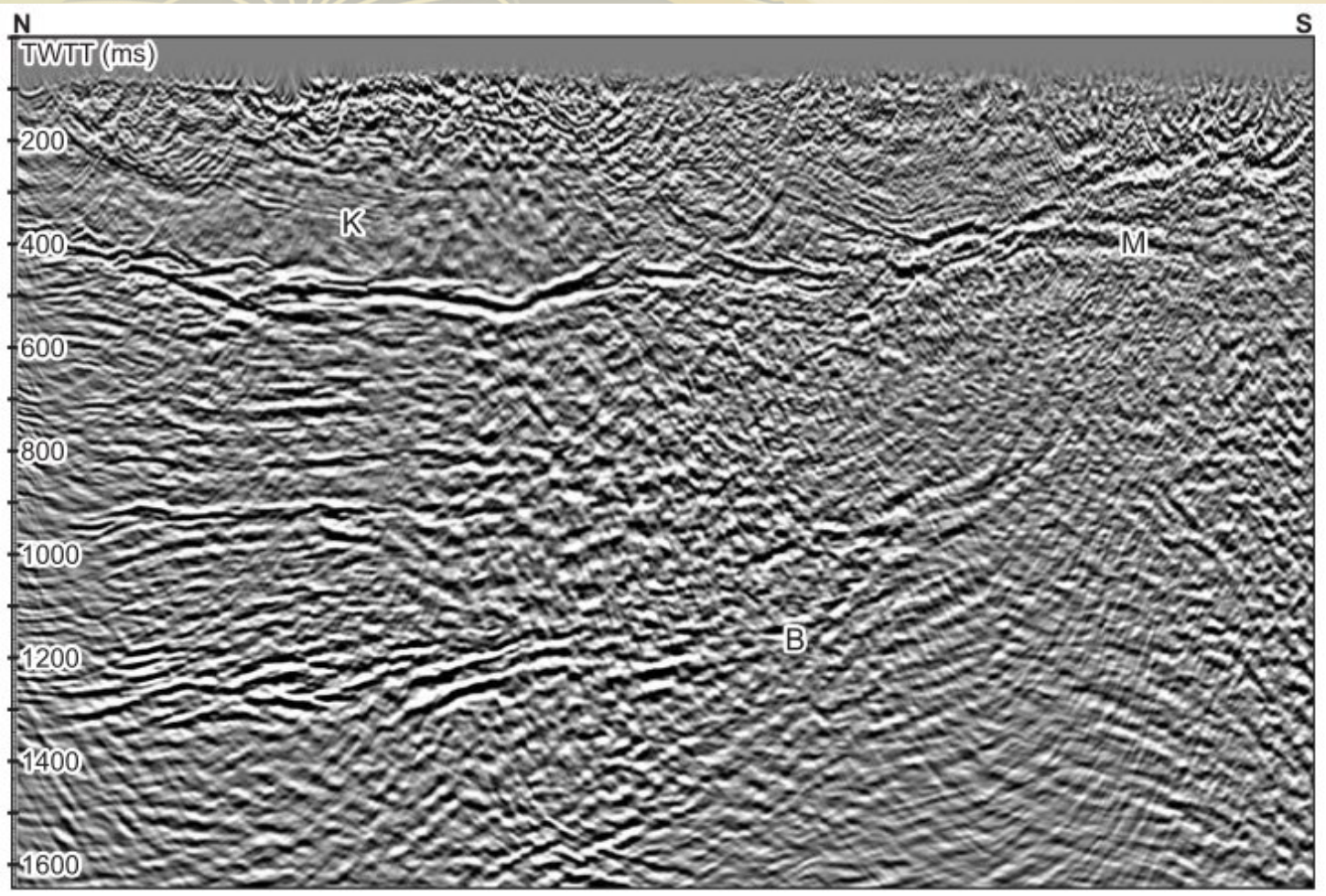

Figure: from Waldron et al., 2010

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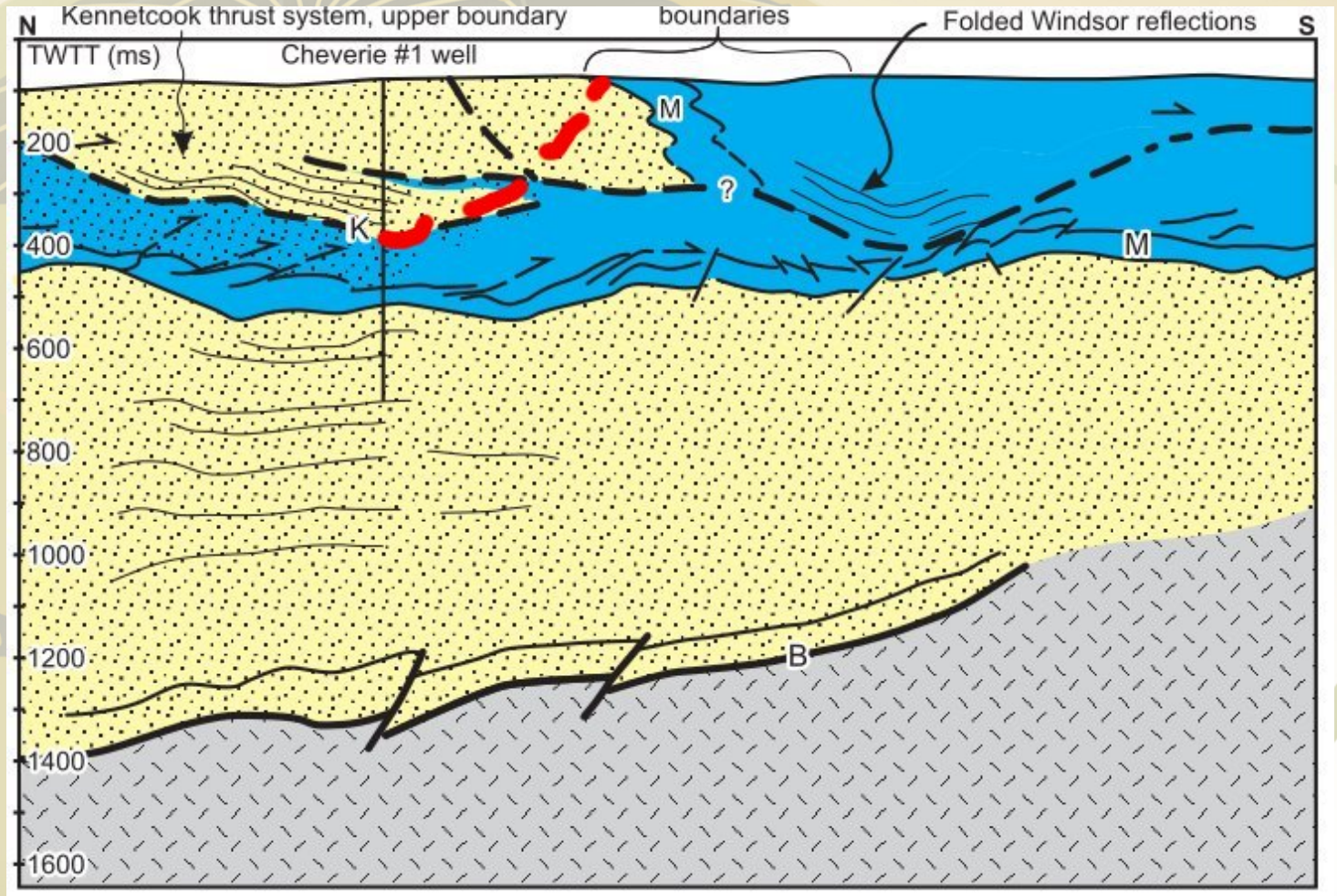


Figure: from Waldron et al., 2010

Interpretation 2 of Wind-03

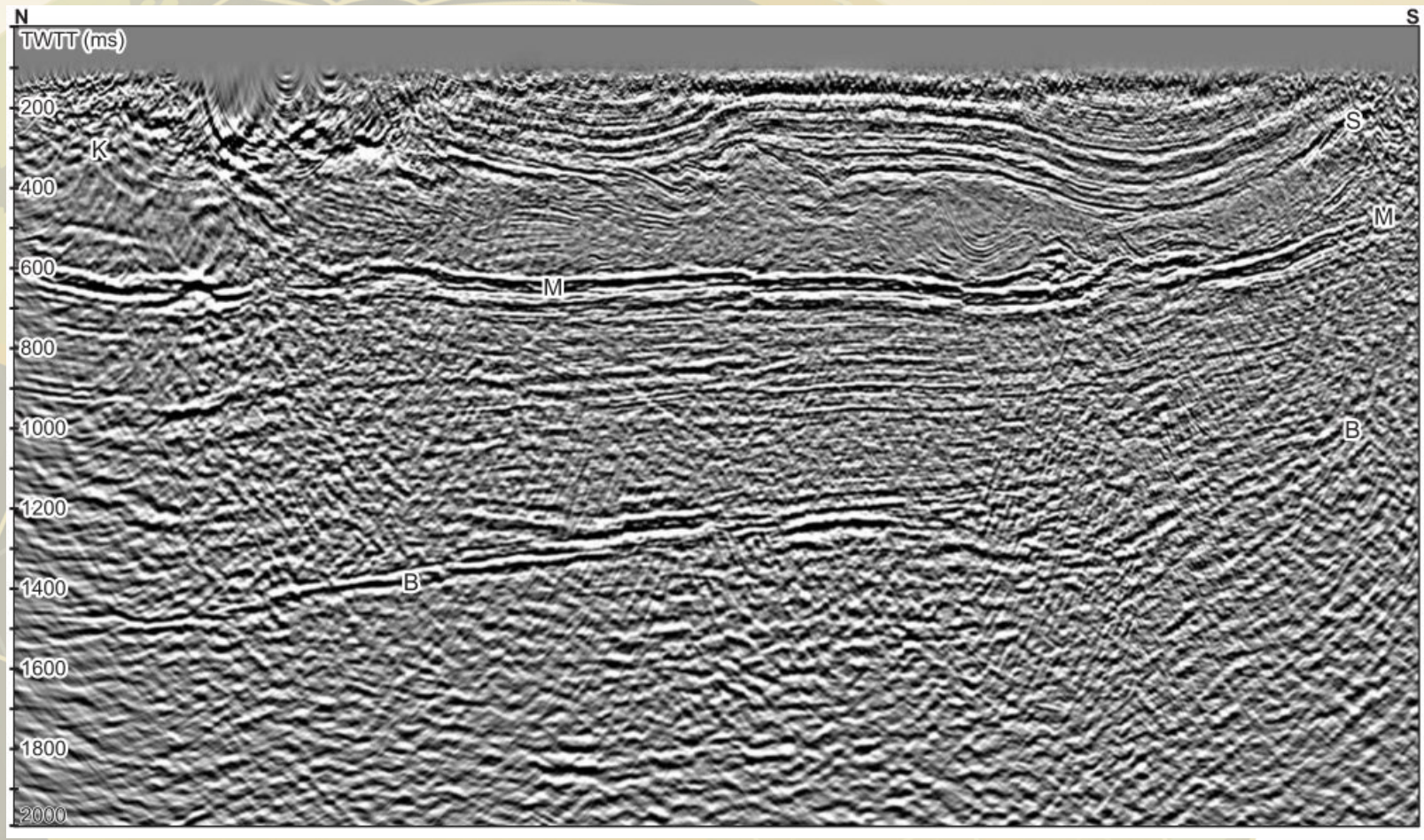


Figure: from Waldron et al., 2010

Interpretation 2 of Wind-03

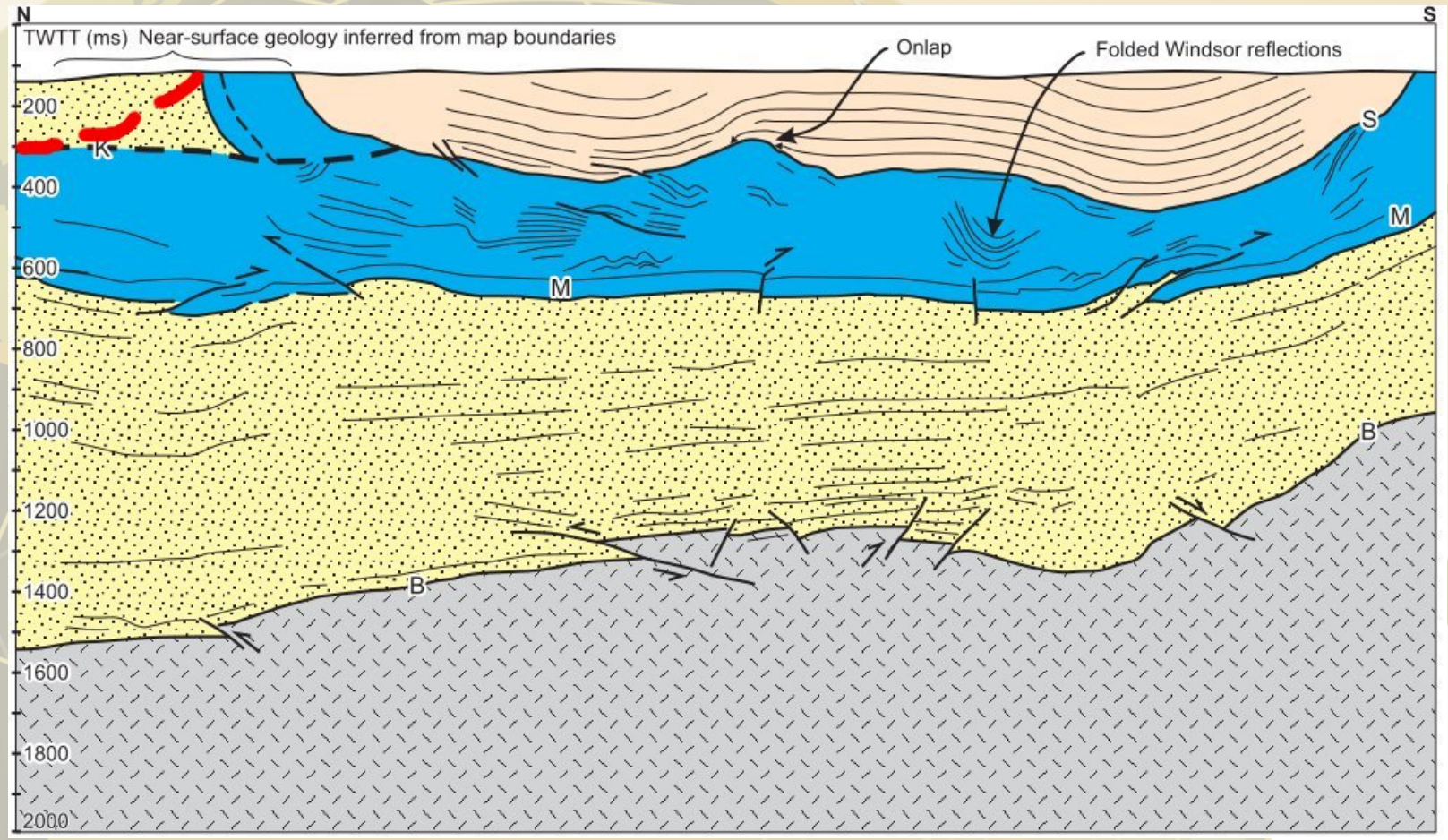


Figure: from Waldron et al., 2010

Summerville

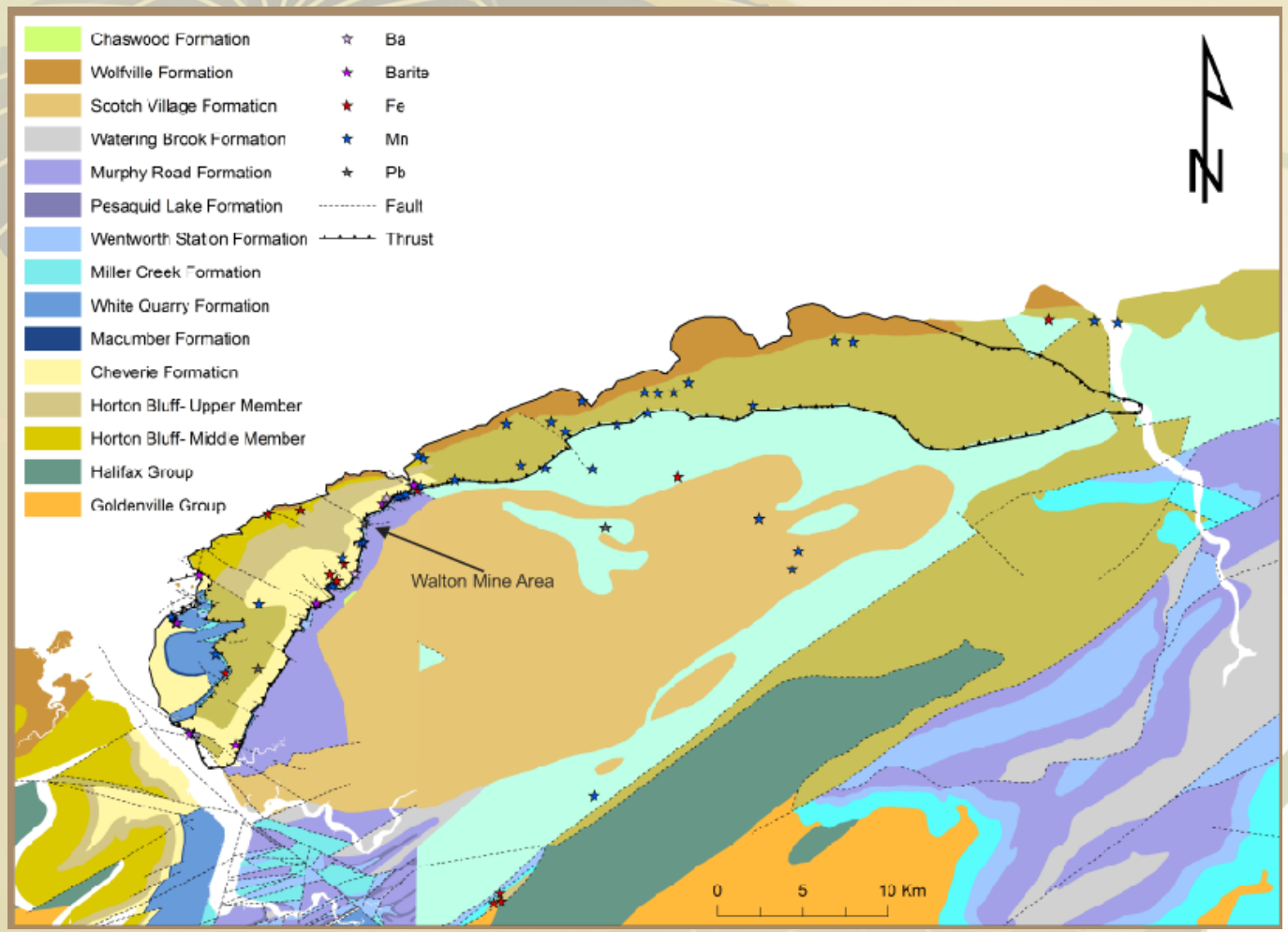


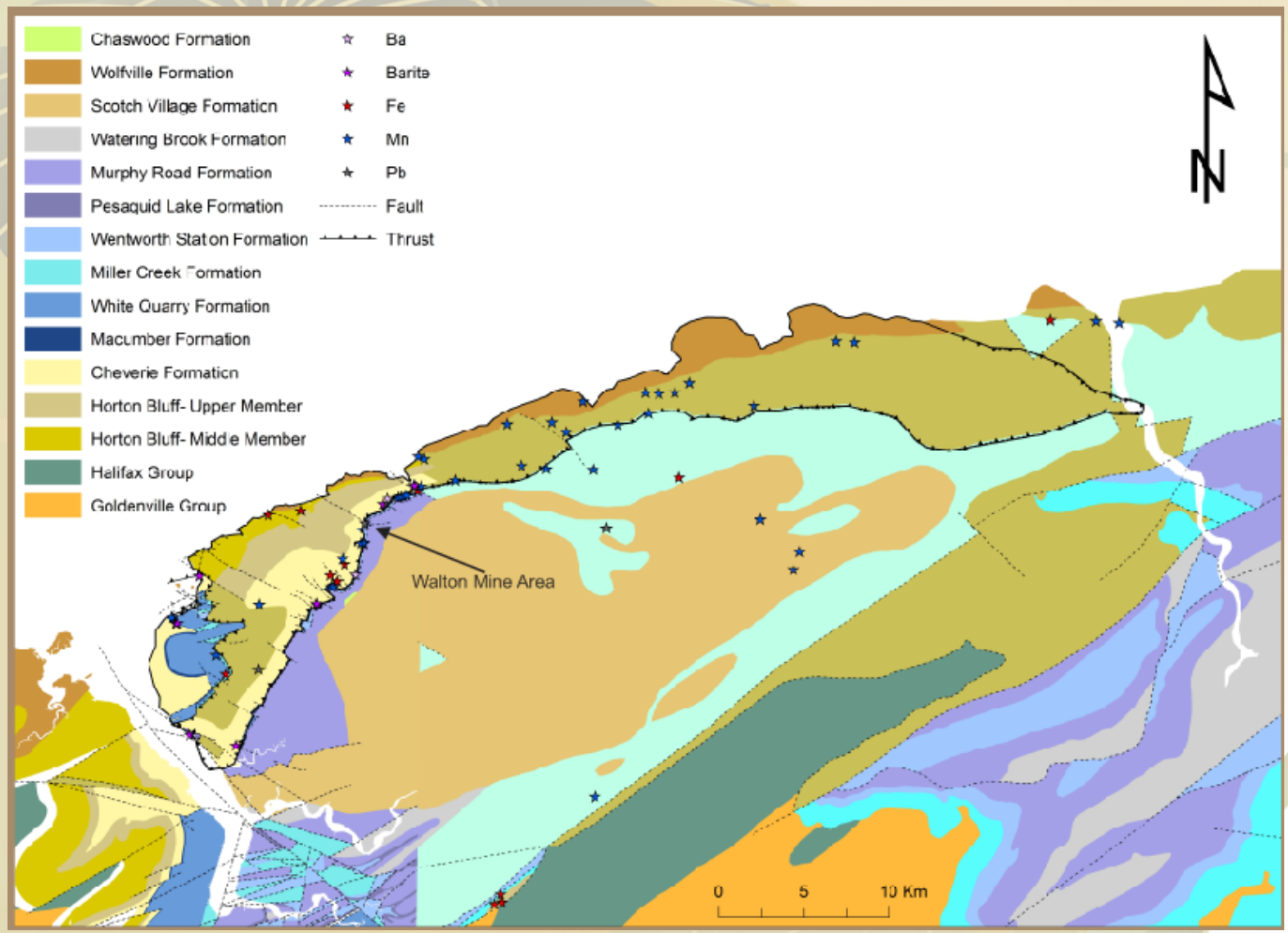
Figure: from Broughm & Keppie, 2013

Summerville

Summerville

Summerville

Walton Mine



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Walton Mine

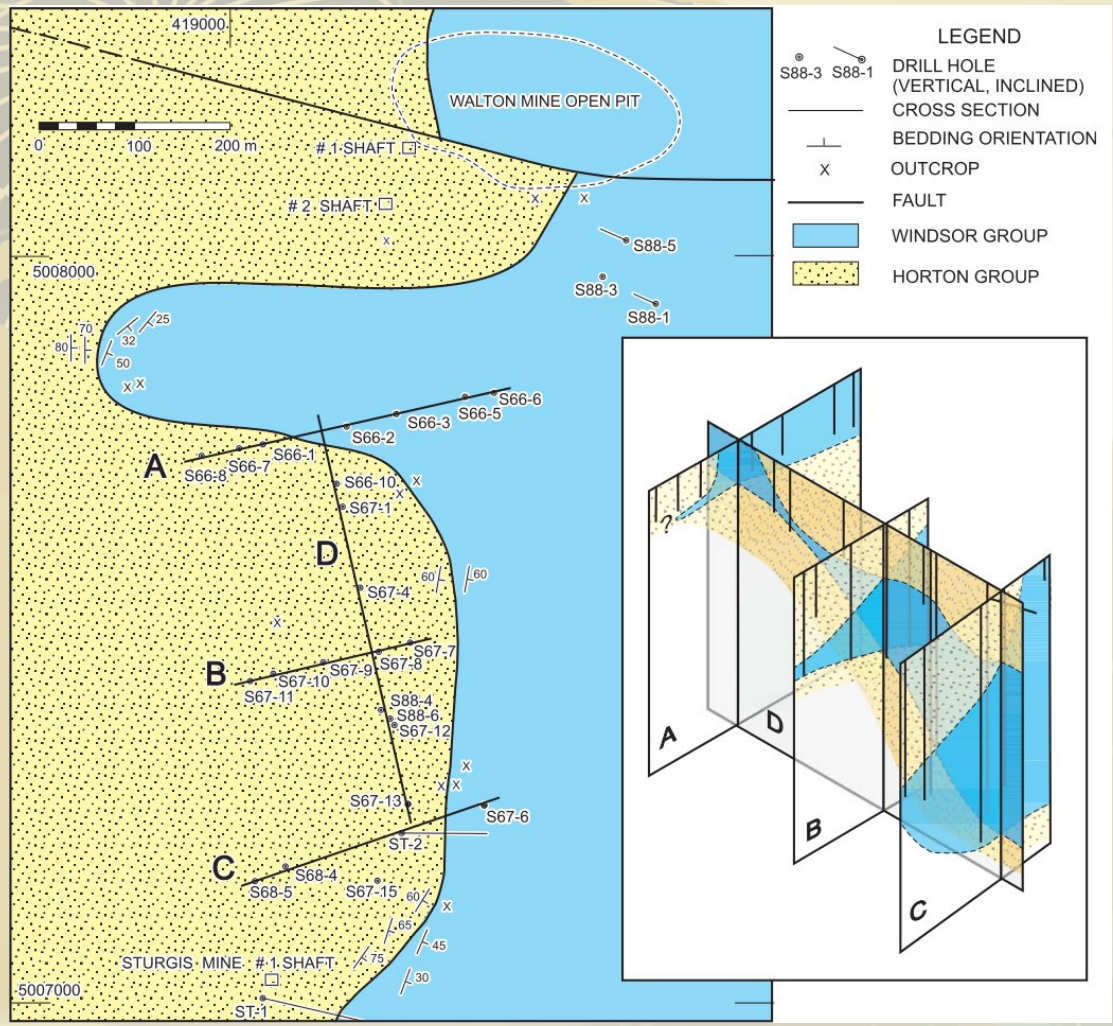

Figure: from Waldron et al., 2007

Walton Mine

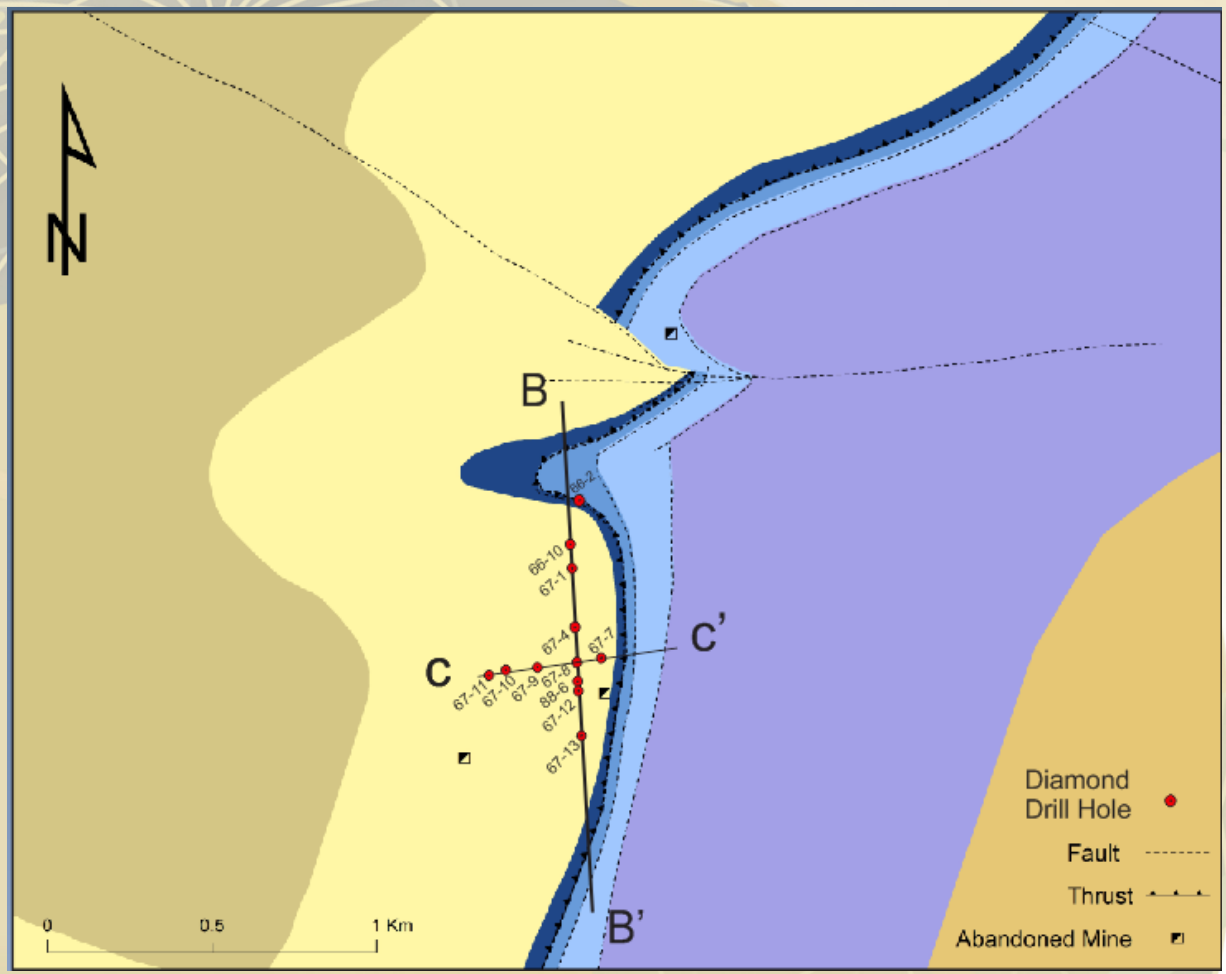

Figure: from Broughm & Keppie, 2013

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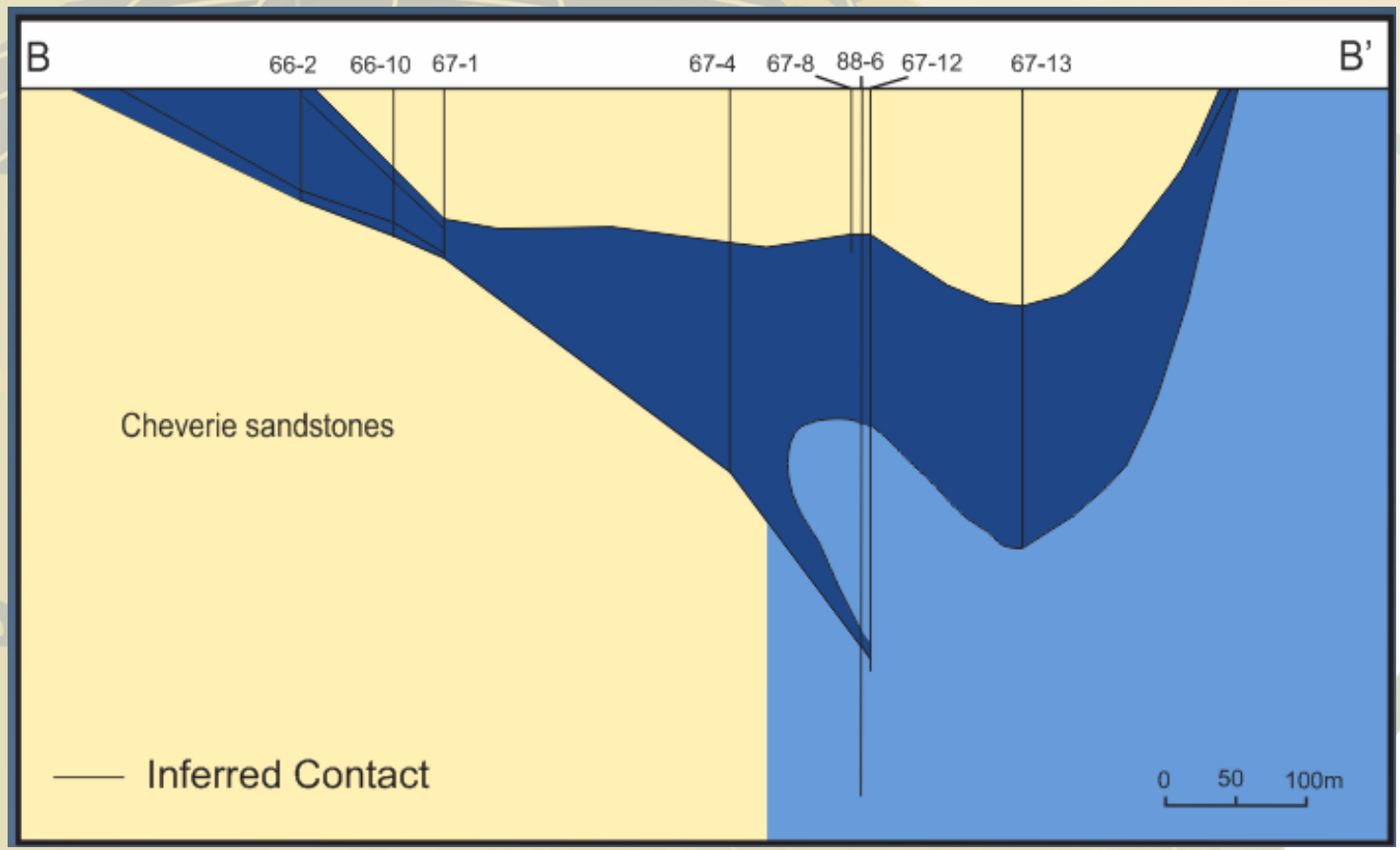

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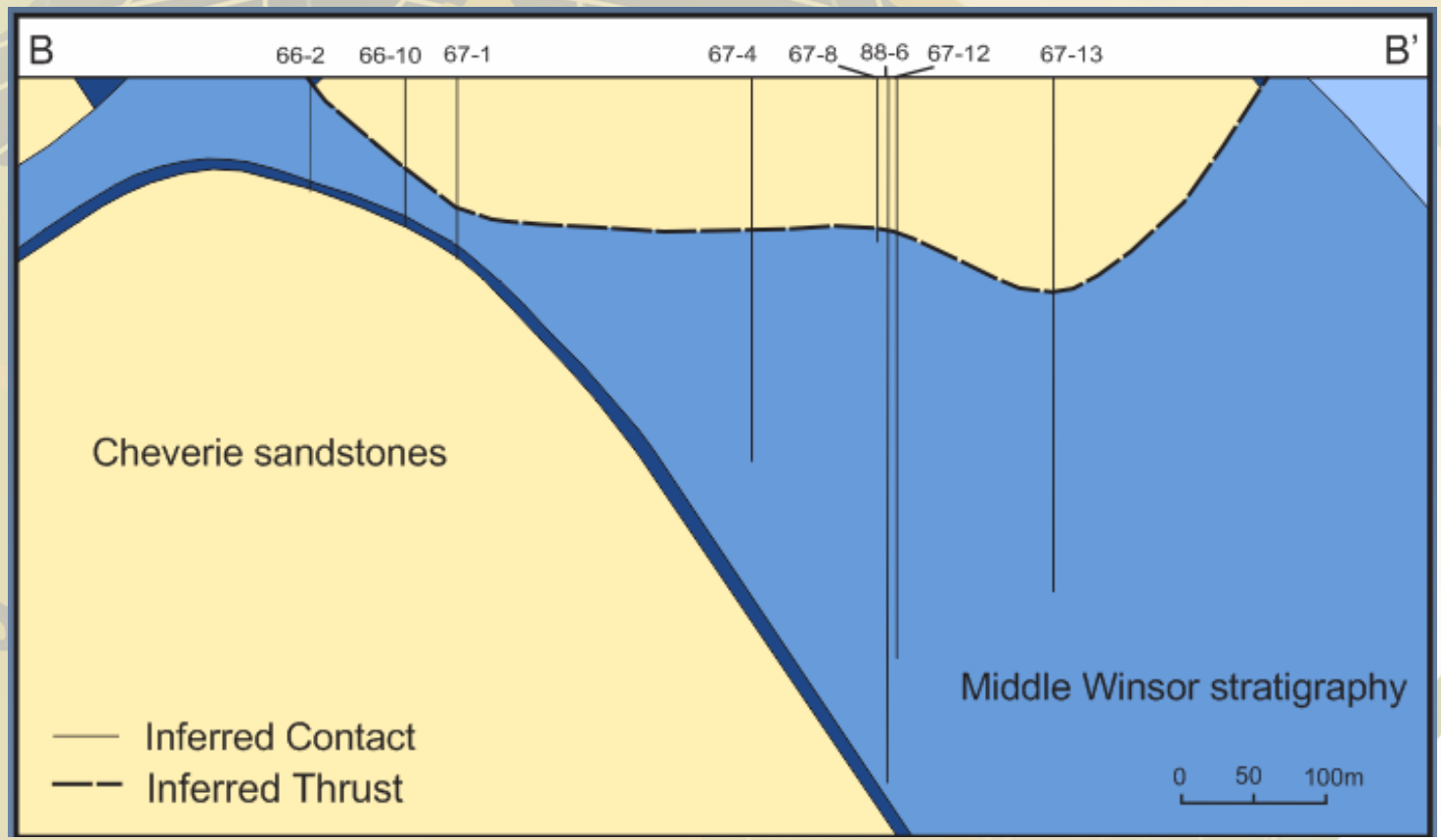

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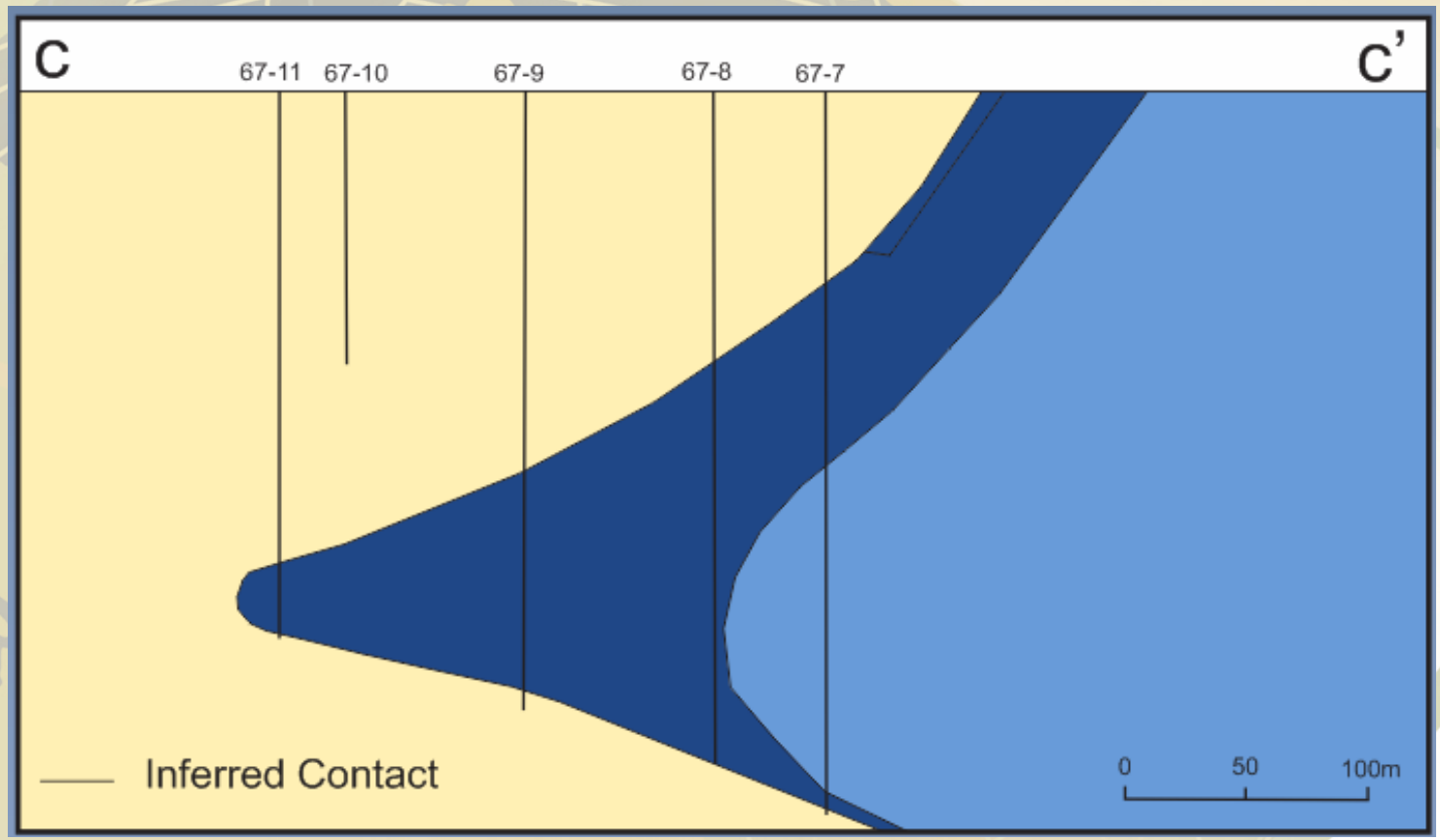

Figure: from Broughm & Keppie, 2013

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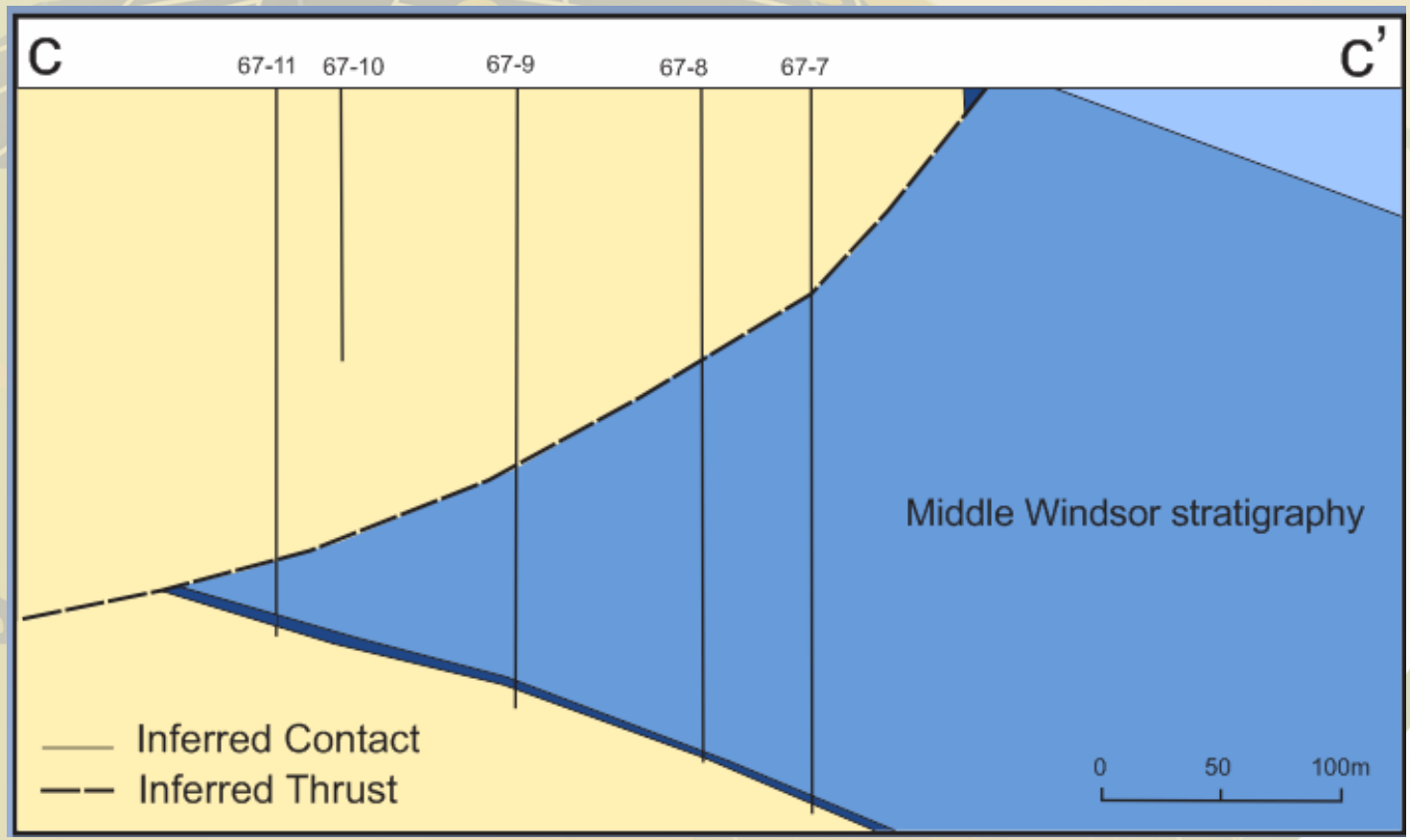

Figure: from Broughm & Keppie, 2013

Windsor-Kennetcook East

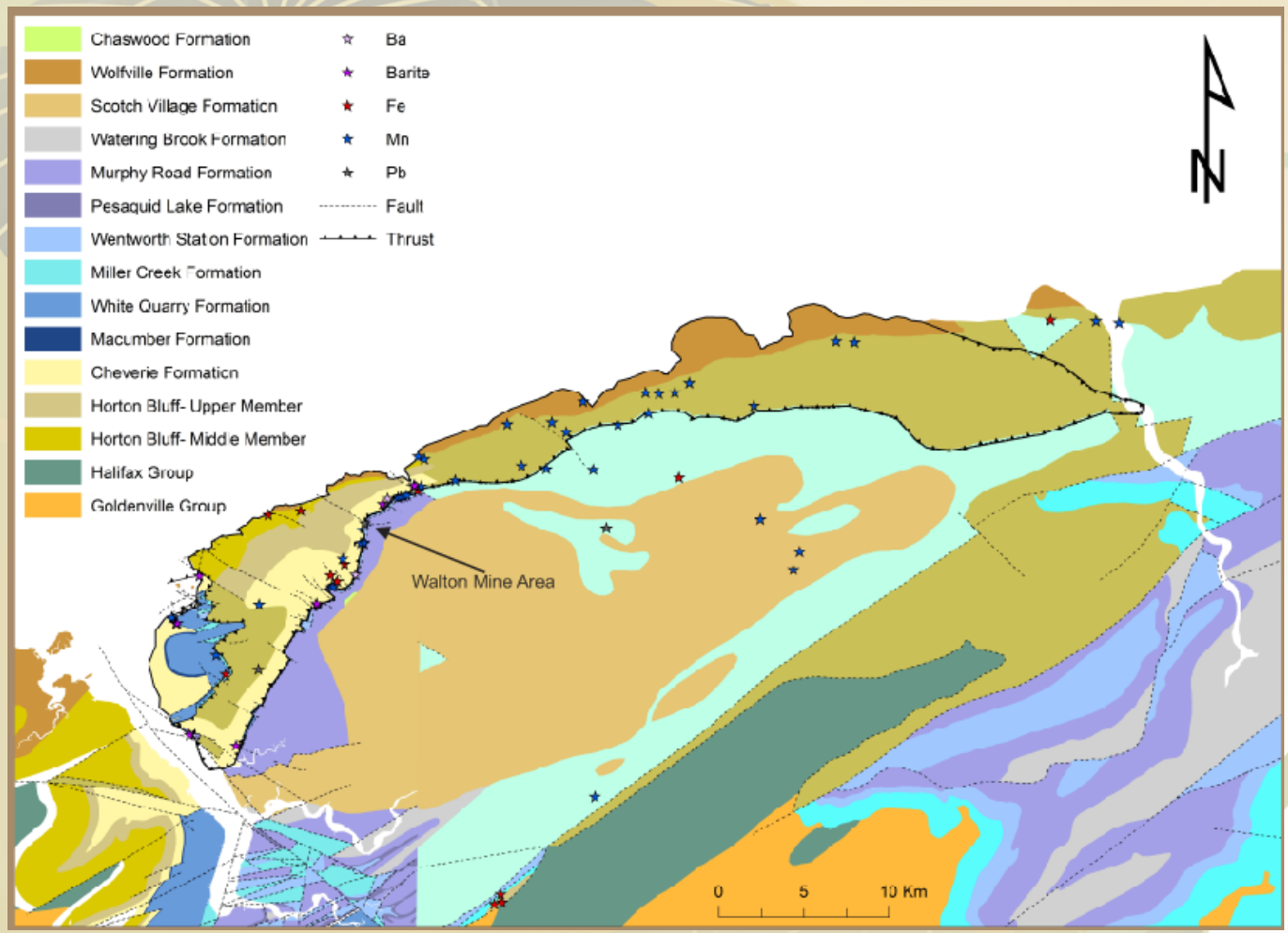

Figure: from Broughm & Keppie, 2013

Windsor-Kennetcook East

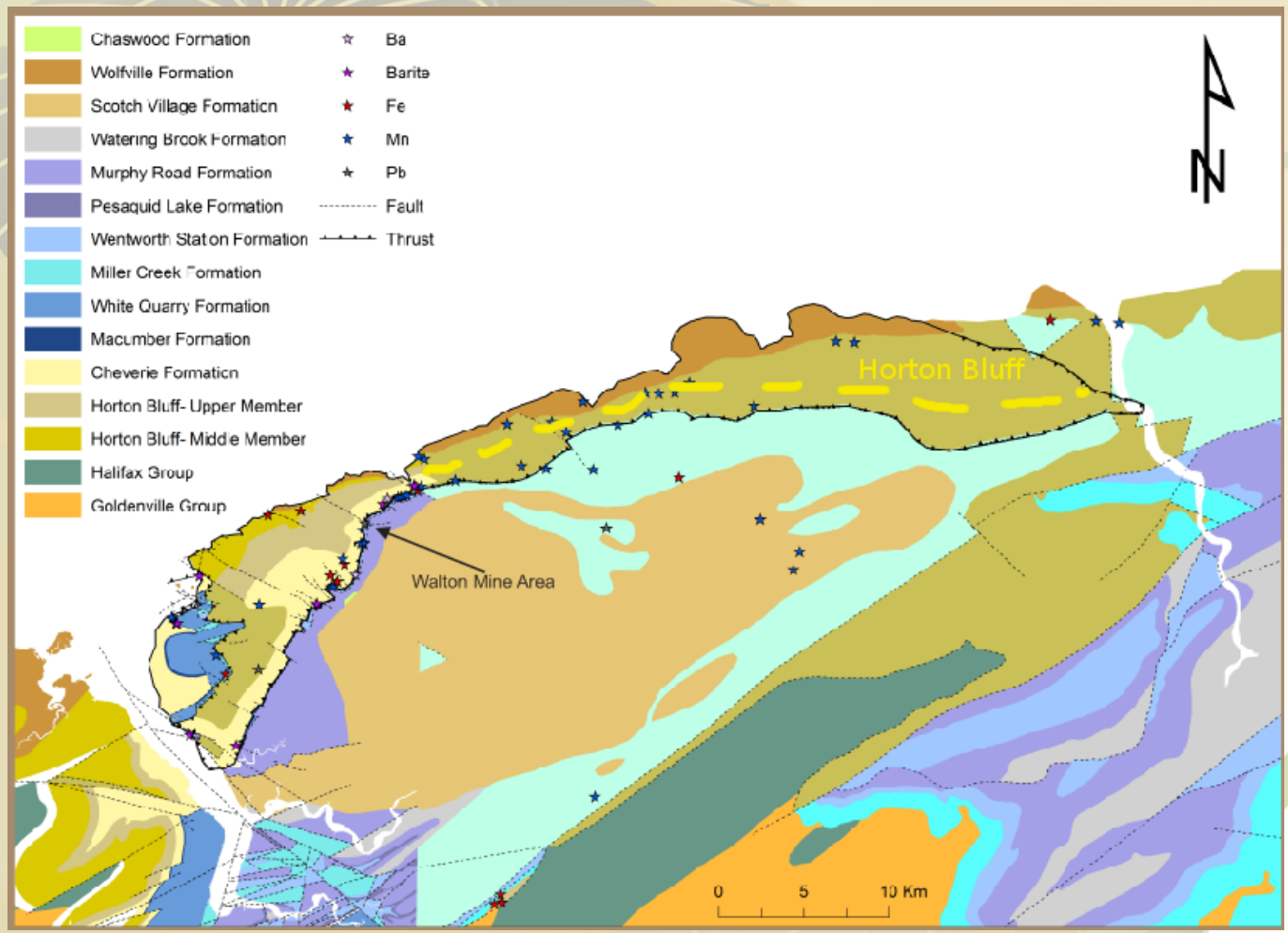

Figure: from Broughm & Keppie, 2013

Walton Thrust Model: Nappe with Tectonic Windows

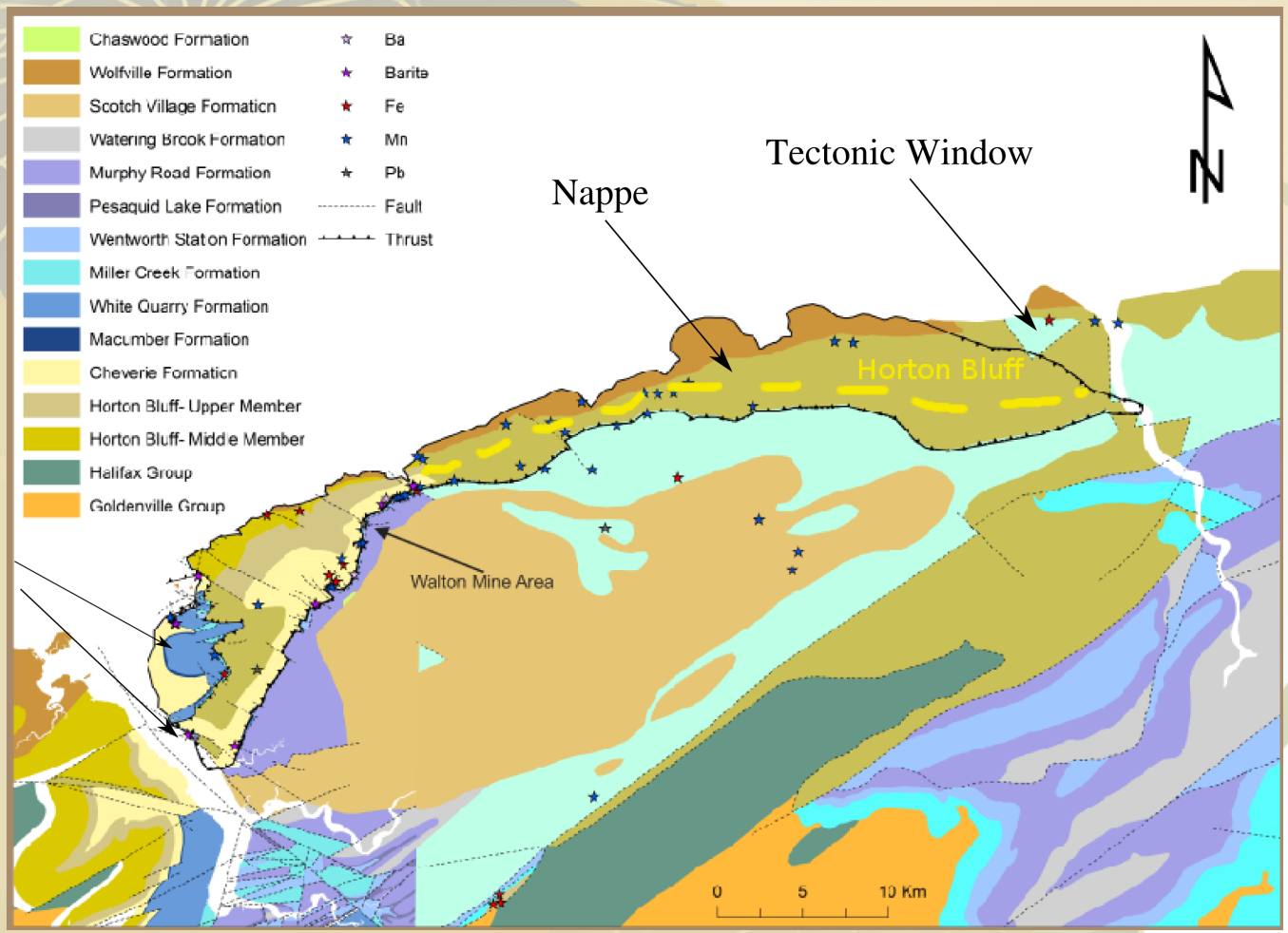

Figure: from Broughm & Keppie, 2013

Walton Thrust Model

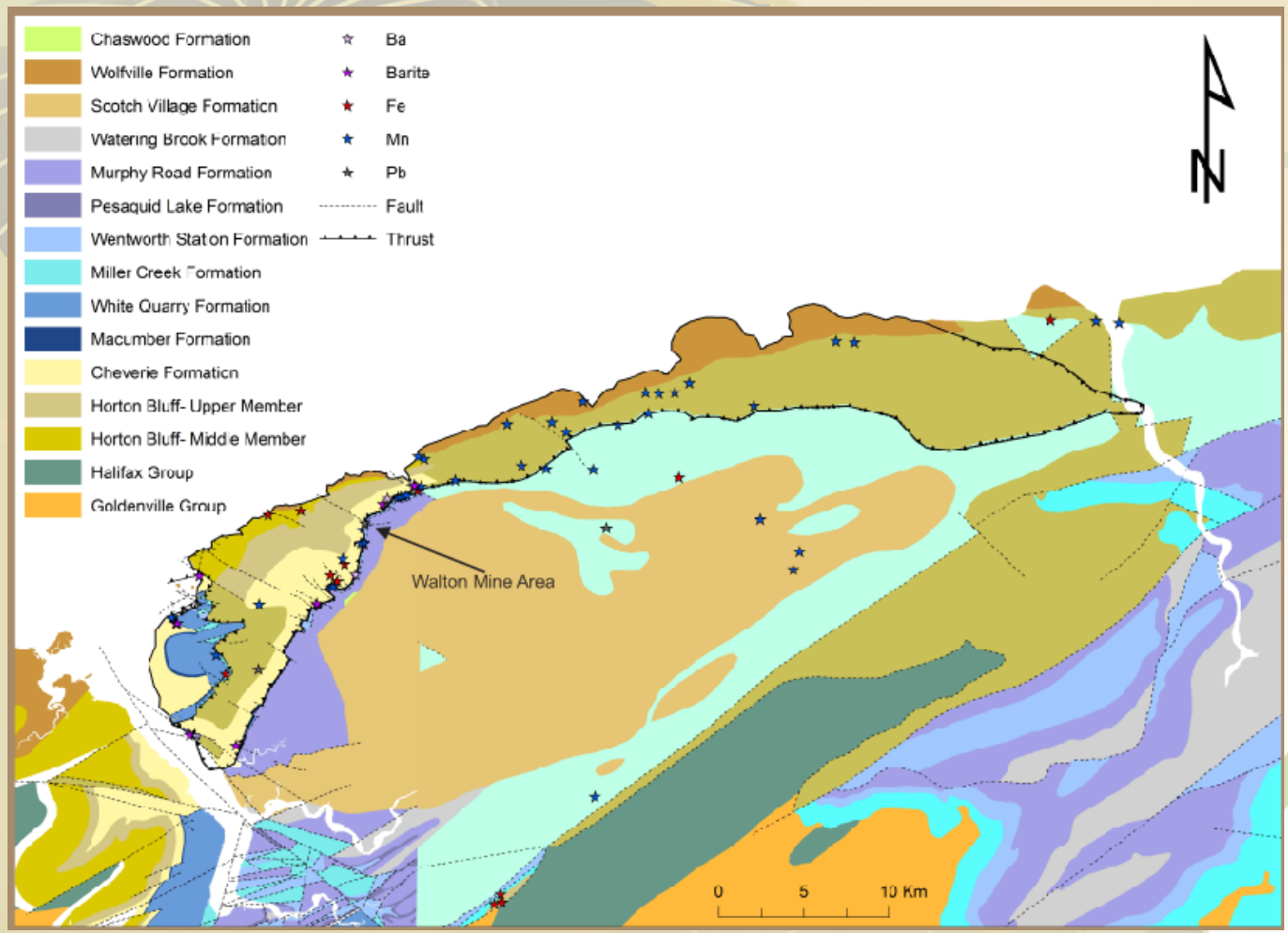

Figure: from Broughm & Keppie, 2013

Walton Thrust Model

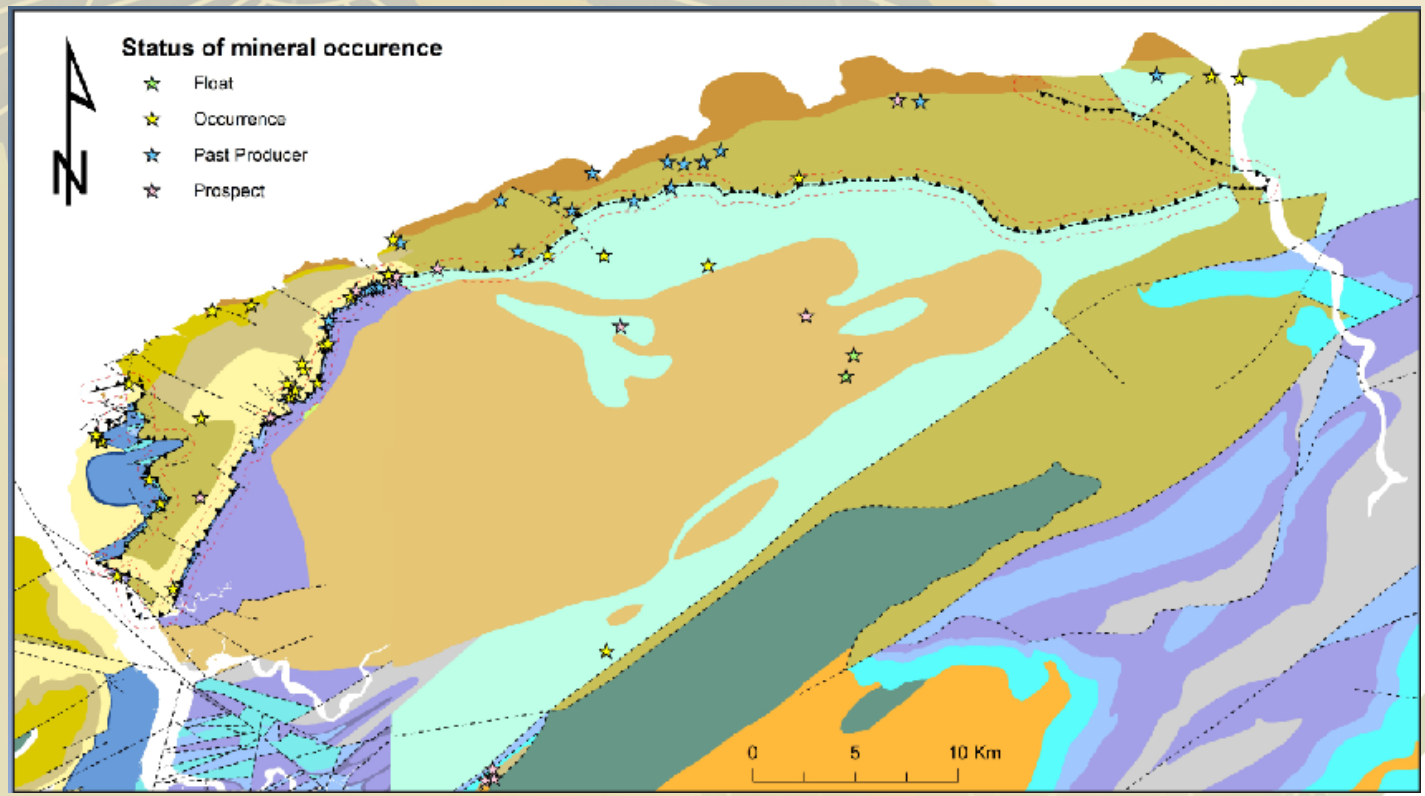

Figure: from Broughm & Keppie, 2013

Walton Thrust Model

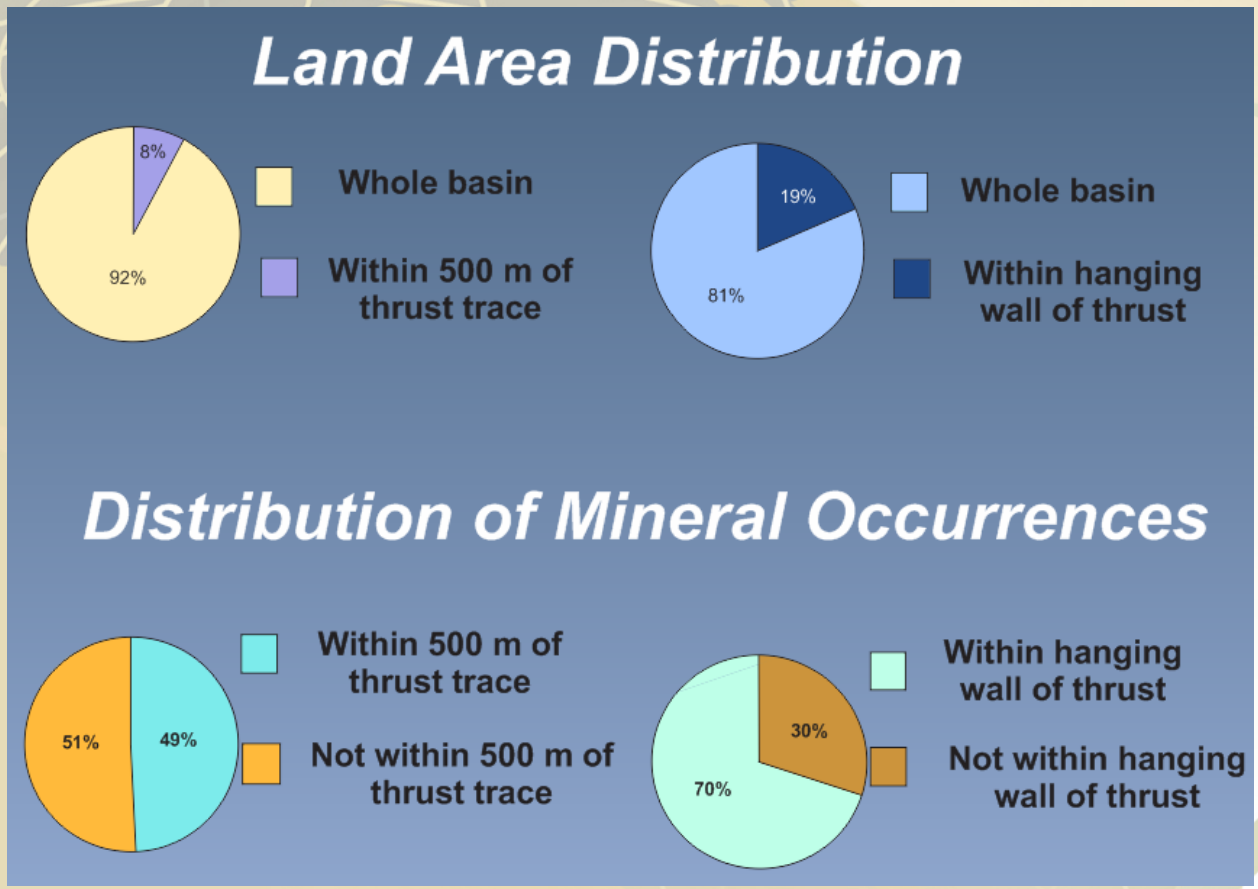

Figure: from Broughm & Keppie, 2013

Conclusion

Thrusts provide a spatial control for barite and base metals

Basin age	360 to 290 Ma (Keppie, 2000)
Thrust age	320 to >315 Ma (Waldron et al., 2010)
Fluid age	300 Ma (Ravenhurst et al., 1989)
Correlation	50% of mineral occurrences within 500m of (newly?) inferred thrusts (Broughm and Keppie, 2013)
Further work	Correlation may improve as adjacent sub-basins are considered as well (Giles, pers. comm.)

NOVA SCOTIA

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References

- Please contact Fraser Keppie (keppiedf@gov.ns.ca)
- or see accompanying Geology Matters 2013 poster (Broughm & Keppie, 2013 and references therein)