



Detrital Zircon Evidence Requires Revision of Belt Stratigraphy in Southwestern Montana

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Abstract:

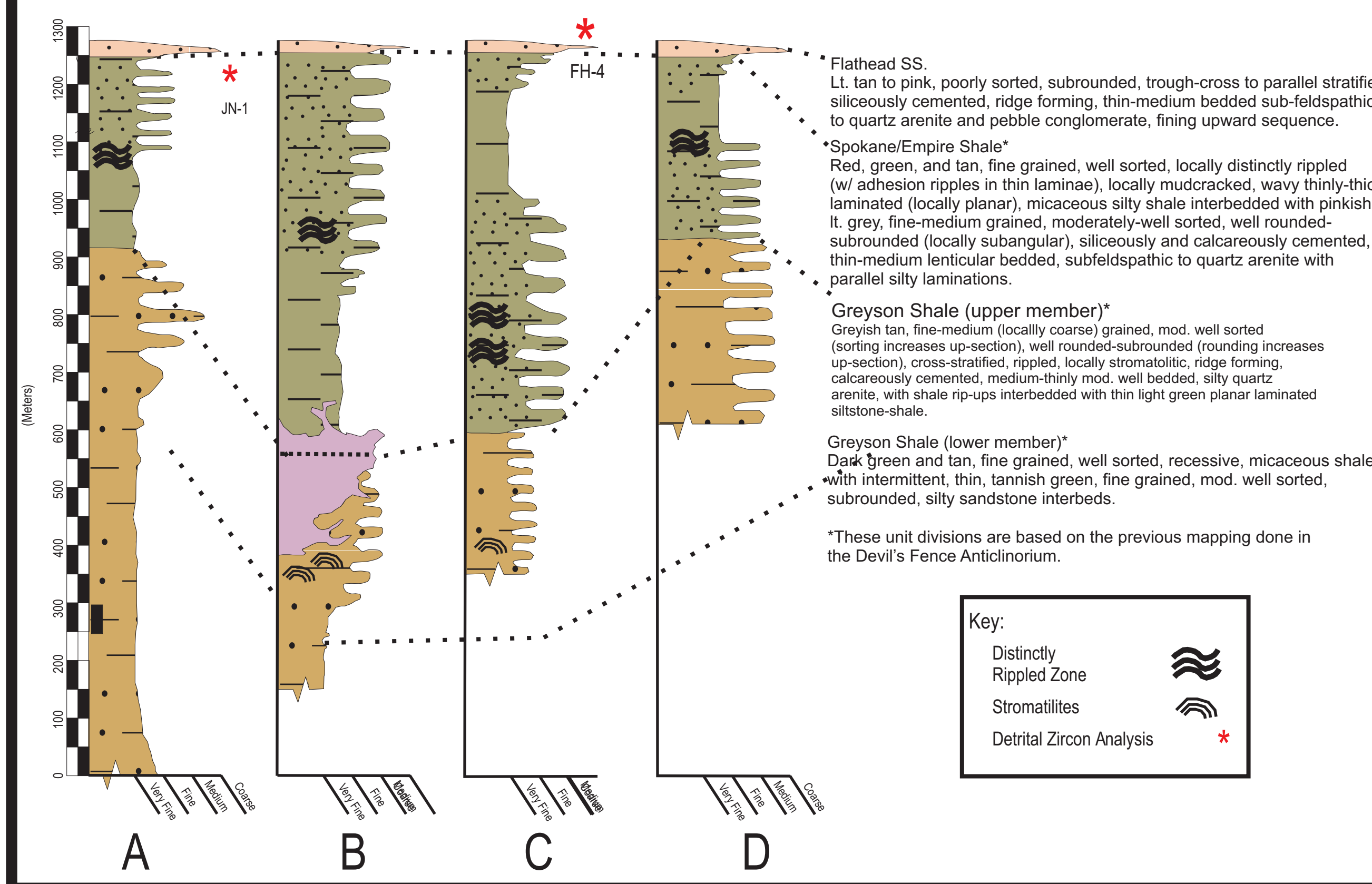
The Belt Supergroup was originally named for widespread exposures of thin-bedded red clastic strata in the Big Belt Mountains in southwestern Montana. Subsequent studies extended the geographic extent and thickness of the Belt Supergroup throughout Montana, Idaho and British Columbia. The nonfossiliferous character of these strata necessitated purely lithostratigraphic correlations. The advent of detrital zircon analyses has provided a method for more rigorous evaluation of proposed correlations.

In southwest Montana, the Belt Supergroup consists primarily of thin-bedded, fine-grained sandstone, siltstone and shale of the Spokane, Empire and Greyson Formations. These rocks are overlain by the Middle Cambrian Flathead Sandstone, which is a prominent, cross-stratified medium to coarse grained quartz arenite that stands in bold relief to the underlying recessive Belt rocks. The contact between these two packages is mapped throughout southwest Montana as a profound unconformity, but recent mapping suggests the contact is actually a conformable, coarsening upward gradational transition.

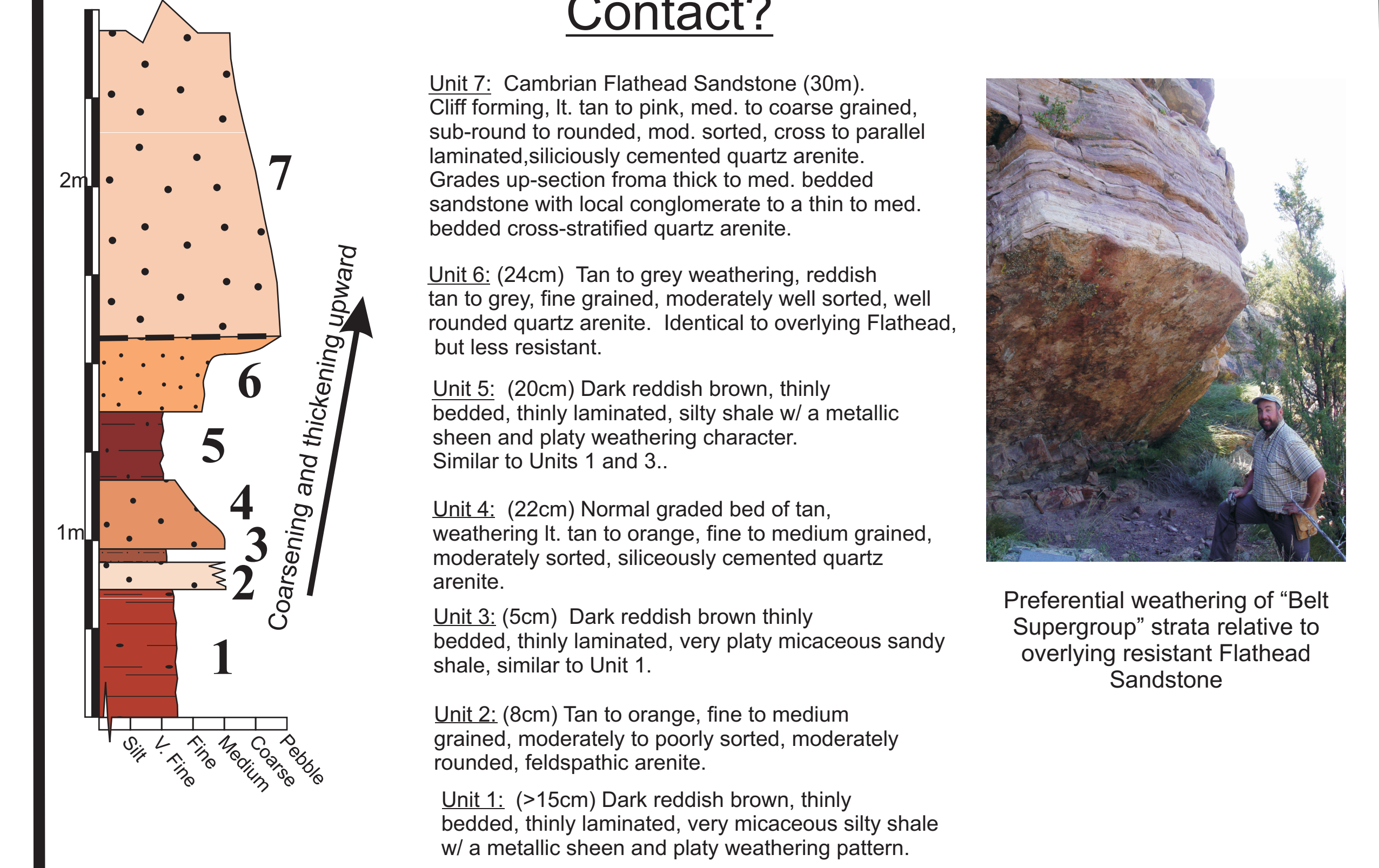
Provenance analysis demonstrates that the two units have very different detrital zircon populations, supporting the existence of an unconformable contact: samples of the Spokane Shale (n=4) yield a major detrital zircon population of 1.45-1.60 Ga, which corresponds to the North American magmatic gap and suggests derivation from a western craton source. The overlying Flathead (n=5) yields distinct peaks at 1.7-1.8 Ga, 2.6-2.7 Ga and 2.9-3.1 Ga, suggesting derivation from the Wyoming craton, or cannibalization of older Belt Supergroup strata.

Recent mapping in the Little Belt Mountains documents a thick succession of recessive red siltstone and shale typical of the Spokane Formation that is both intercalated with thin beds of coarse-grained, ripple marked, quartz arenite and overlain by cross-stratified quartz arenite of the Flathead sandstone. Detrital zircon analysis demonstrates that these red strata yield a zircon population typical of the Spokane Formation, and both the intercalated and the overlying sandstone yield a typical Flathead detrital zircon signature. The coarsening upward nature of the succession, existence of an apparent conformable, gradational contact, and the intercalation of the two distinct zircon populations strongly suggests that rocks mapped as the Spokane Formation of the Middle Proterozoic Belt Supergroup in the Little Belt Mountains and adjacent region are actually Early to Middle Cambrian in age, and conformably underlie the Flathead Sandstone.

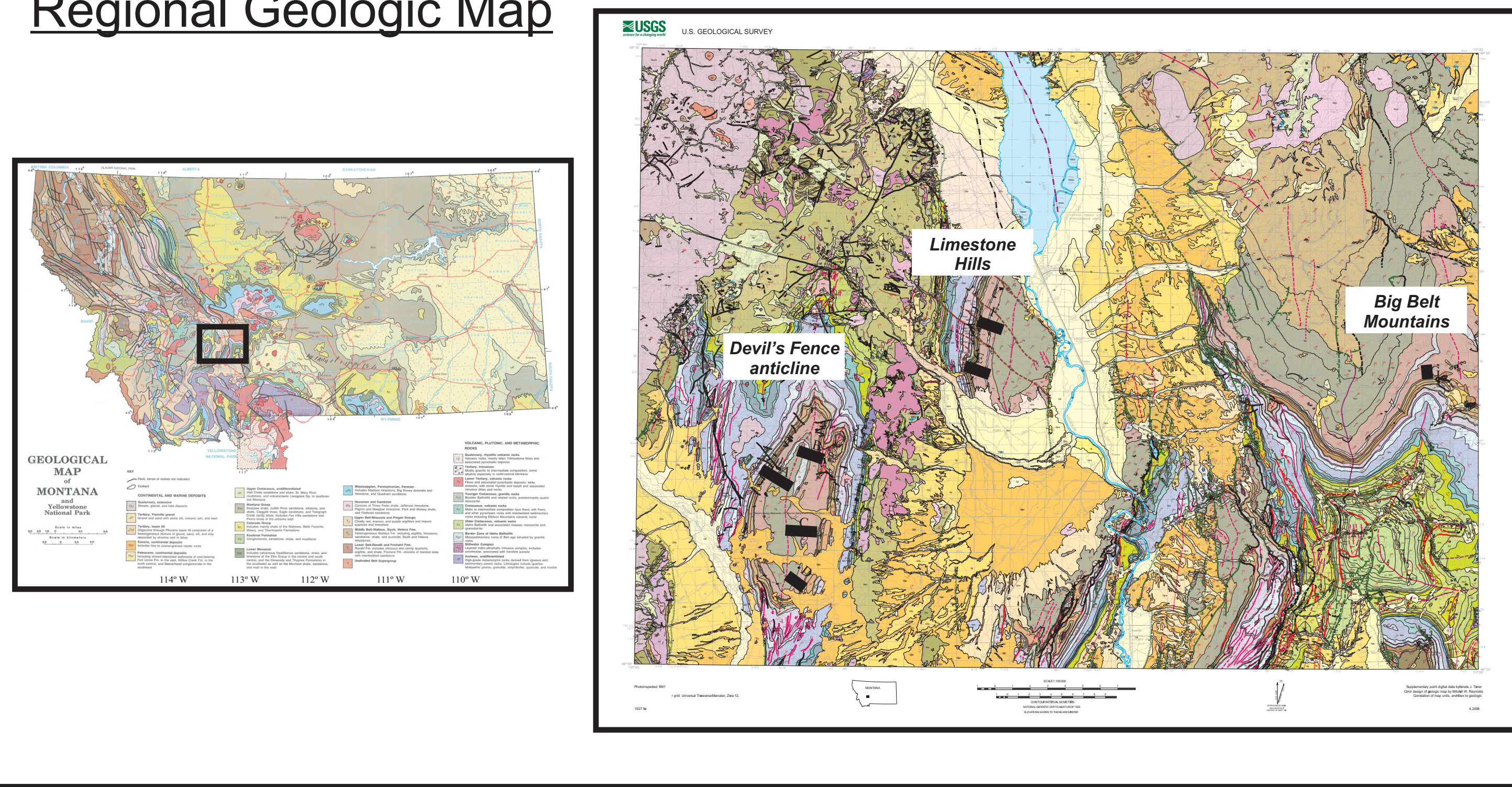
Stratigraphy in the Devil's Fence Anticlinorium



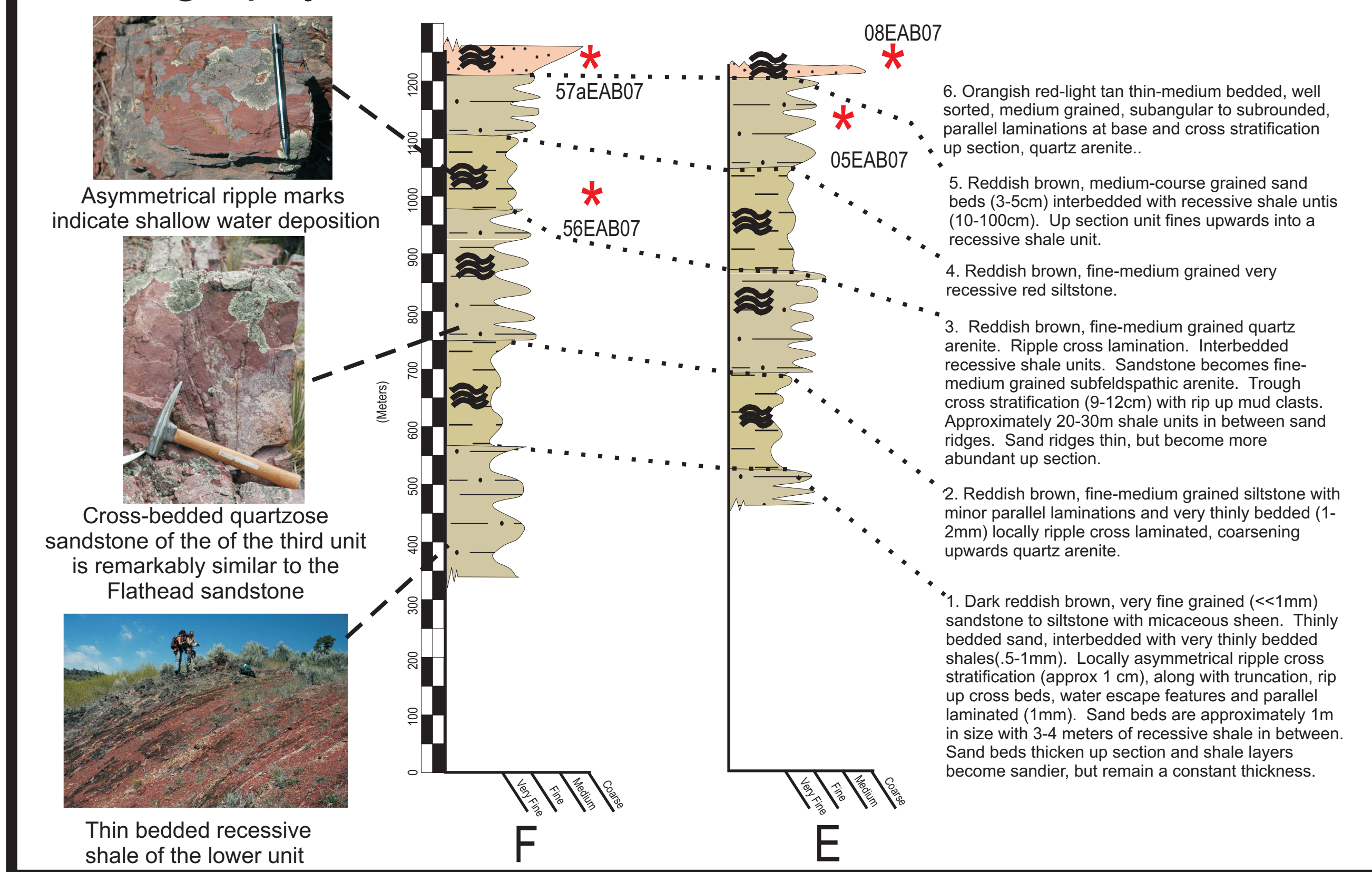
Mesoproterozoic-Cambrian Contact?



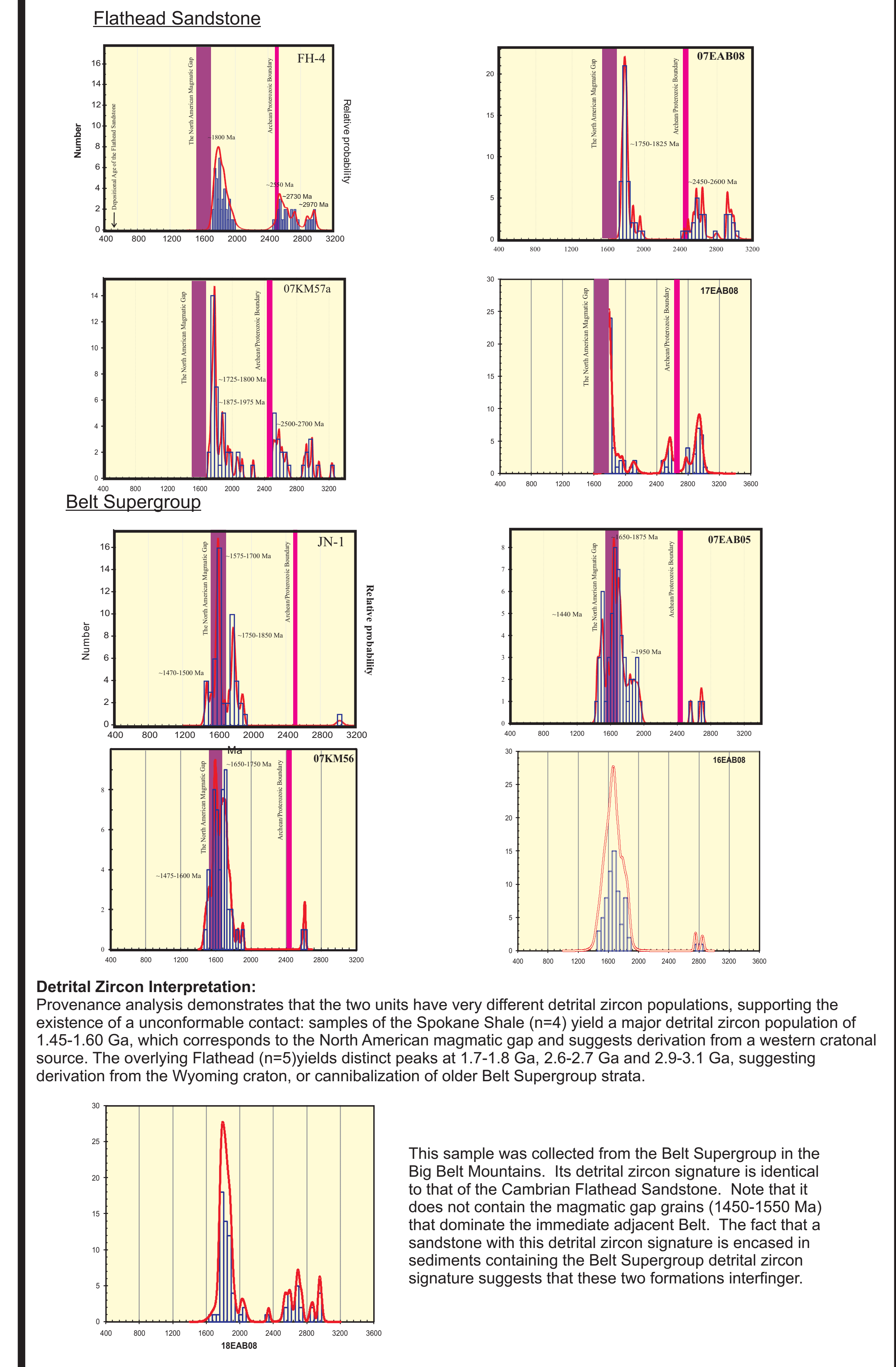
Regional Geologic Map



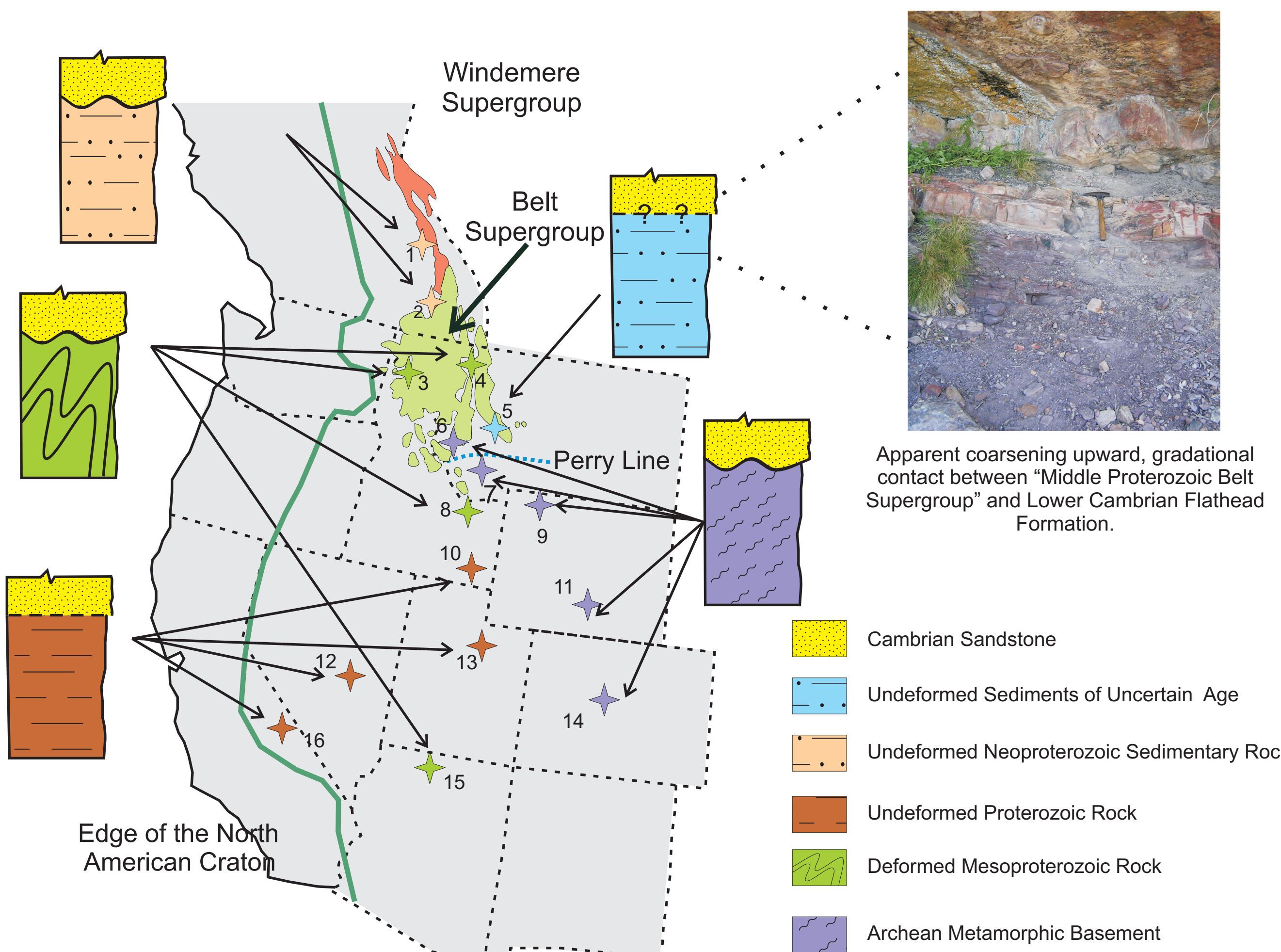
Stratigraphy in the Limestone Hills



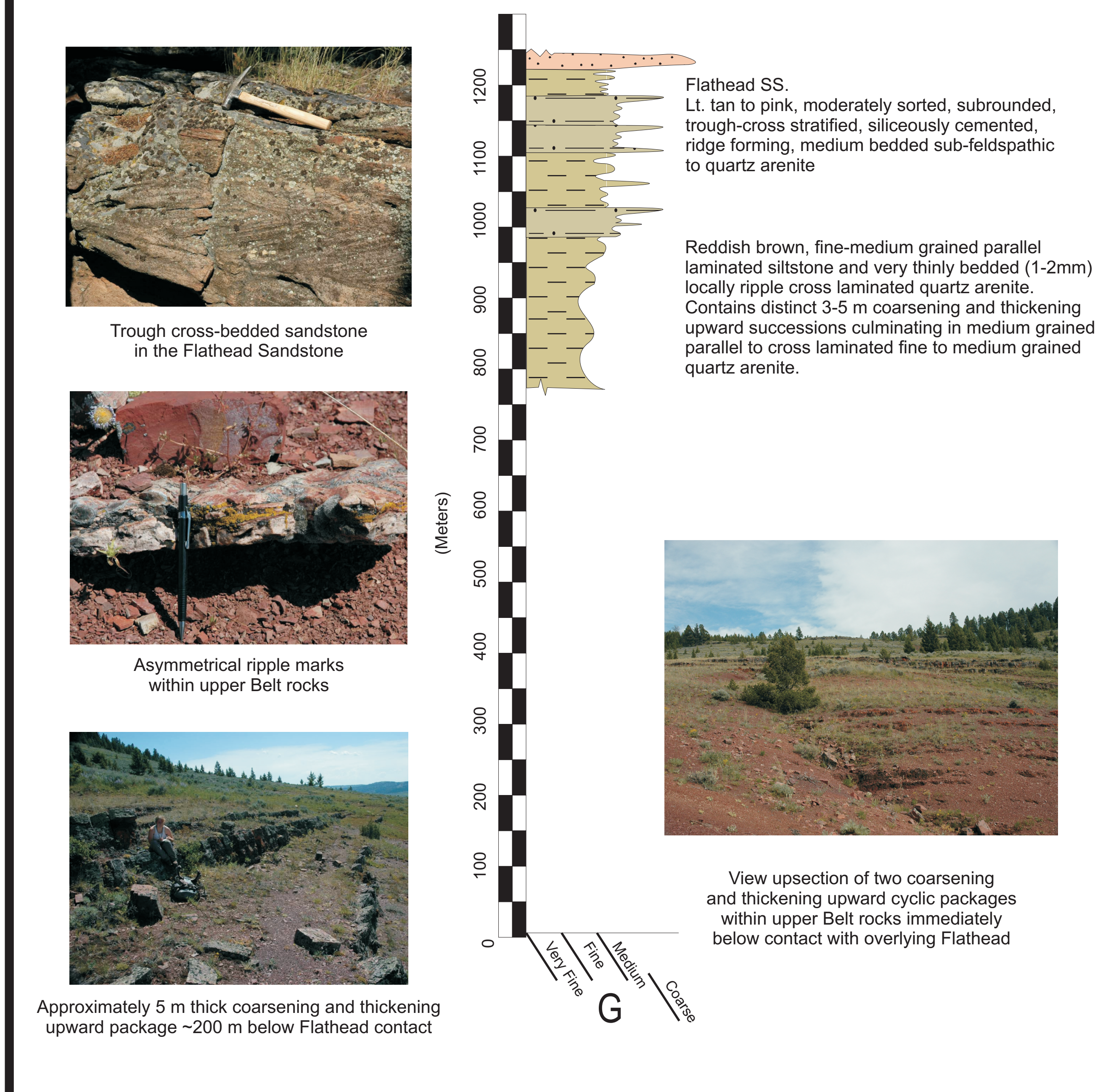
Detrital Zircon Analysis



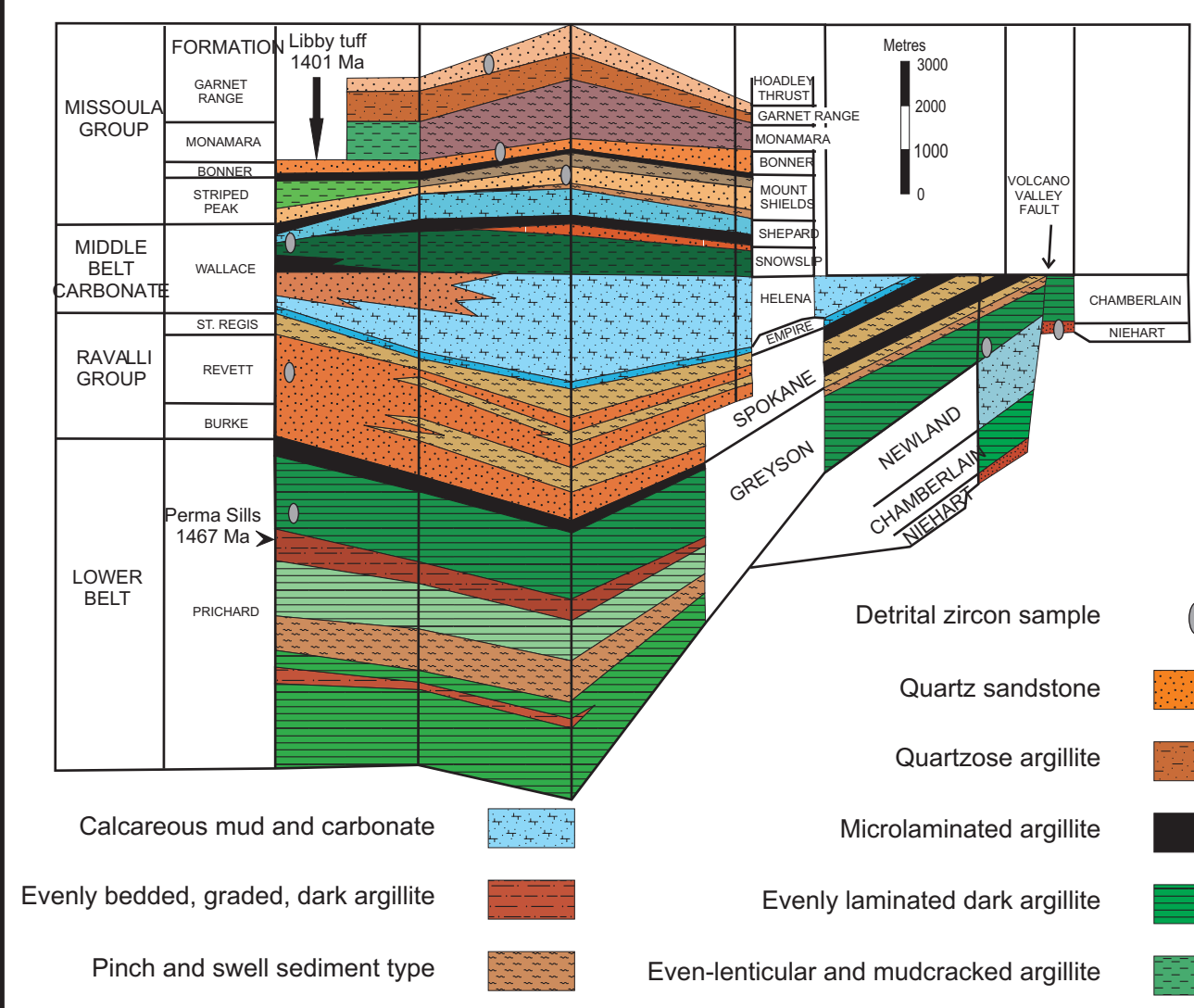
Nature of the Basal Cambrian Contact in Western North America



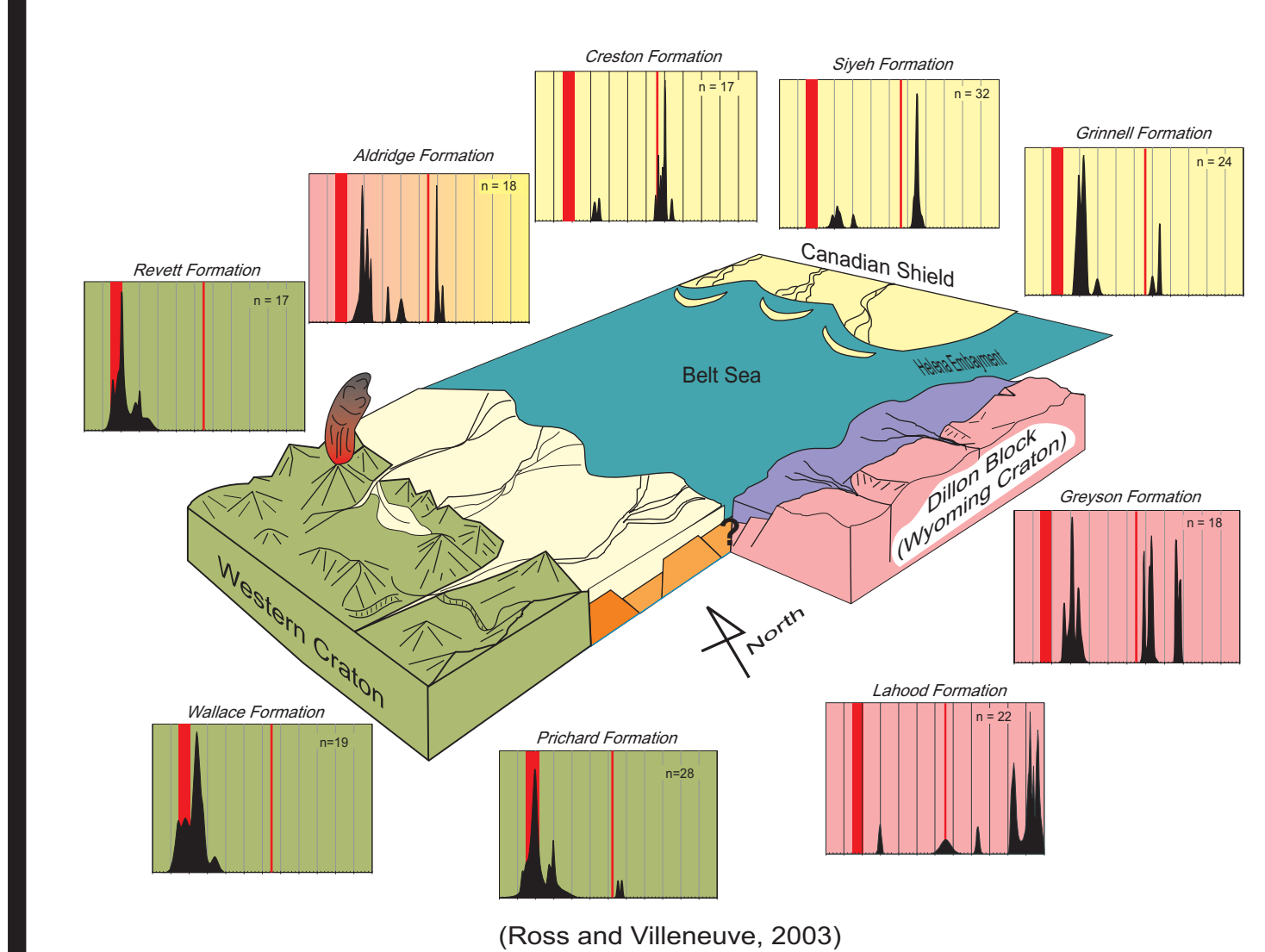
Generalized Stratigraphy from the Big Belt Mountains



Belt Basin Stratigraphy



Belt Basin Paleogeography



Conclusion

Recent mapping in the Little Belt Mountains documents a thick succession of recessive red siltstone and shale typical of the Spokane Formation that is both intercalated with thin beds of coarse-grained, ripple marked, quartz arenite and overlain by cross-stratified quartz arenite of the Flathead sandstone. Detrital zircon analysis demonstrates that these red strata yield a zircon population typical of the Spokane Formation, and both the intercalated and the overlying sandstone yield a typical Flathead detrital zircon signature. The coarsening upward nature of the succession, existence of an apparent conformable, gradational contact, and the intercalation of the two distinct zircon populations strongly suggests that rocks mapped as the Spokane Formation of the Middle Proterozoic Belt Supergroup in the Little Belt Mountains and adjacent region are actually Early to Middle Cambrian in age, and conformably underlie the Flathead Sandstone.