CORRELATIONS AND CONTRASTS IN STRUCTURAL HISTORY AND STYLE BETWEEN AN ARCHEAN GREENSTONE BELT AND ADJACENT GNEISS BELT, NE MINNESOTA; R.L. Bauer, Dept. of Geology, University of Missouri, Columbia, MO 65211, P.J. Hudleston, Dept. of Geology and Geophysics, University of Minnesota, Minneapolis, MN 55455, and D.L. Southwick, Minnesota Geological Survey, St. Paul, MN 55114.

Introduction. Low-grade metagraywacke and greenstone of the Vermilion district and amphibolite facies schist and migmatites of the Vermilion Granitic complex (VGC) are separated by a series of east-trending dip-slip and strike-slip faults (1). Structural analysis in the boundary region between these two terranes indicates that they both sustained an early D_1 deformation which lead to recumbent folding. This was followed by a north-south transpression that resulted in the generation of upright F_2 folds and locally well-developed, dextral, D_2 shear zones (2). Despite these correlations, there are distinct differences in structural style and late-stage fold history between the two terranes that we attribute to: 1. differences in the crustal levels of the two terranes during deformation, and 2. effects of late-D_2 plutonism in the VGC.

D_2 deformation produced a series of upright F_2 folds with easterly striking axial planes that are the most prominent fold structures in both terranes. The largest fold of this series is a westerly plunging antiform that straddles the dip-slip fault boundary between the two terranes. Large-scale parasitic folds on this structure are invariably of S symmetry in the southern VGC and occur on the northern limb of the antiform. D_2 dextral shear zones are well represented in the Vermilion district where they are generally parallel to the regional F_2 axial planes. Although distinct ductile shear zones are not observed in the VGC, evidence of a D_2 dextral shear component is locally indicated by asymmetrical pull-aparts and rotated vein segments in the migmatites.

F_1 recumbent folding is inferred from structural facing in the major F_2 antiform that crosses the boundary between the two terranes. Facing is downward on both limbs of the fold which is interpreted to be part of the lower, overturned limb of a large-scale F_1 recumbent fold. A change to upward facing strata further south in the Vermilion district indicates a crossing onto the upper limb of this structure. Finite strain data, determined from clasts in sedimentary/volcaniclastic units in the Vermilion district, can be completely accounted for in terms of the deformation producing the F_2 folds (3). Locally intense F_1 folding in these rocks is therefore attributed to deformation in soft or very poorly lithified sediment. However, biotite schists making up part of the same structure in the VGC display a pronounced S_1 foliation that developed parallel to bedding during the early stages of metamorphism. We have suggested that metamorphic dehydration reactions occurring in the lower strata led to the development of high pore pressures in the upper portion of the sedimentary pile (4 and 5). The combination of high pore pressures and gravitational instability during the F_1

folding resulted in soft-sediment, coherent down-slope movement in the upper strata while the lower strata underwent strain and metamorphic rescrystallization during F_1 folding. Soft-sediment F_1 folding in the Vermilion district could have led to a rather complex distribution of F_1 structures, because the more competent greenstones could not have been soft and therefore may have undergone a much different response to the F_1 folding.

F_3 folding has been observed only in the VGC to the north of the boundary zone with the Vermilion district, near the southwestern contact between the migmatites and the Lac La Croix Granite batholith. Along this margin of the batholith, F_2 folds were reoriented during the emplacement of the pluton and subsequently refolded by F_3 conical folds that formed during the waning stages of the regional north-south transpression that generated the F_2 folds. Such F_3 folds are not observed along the southern margin of the batholith where the F_2 folds are parallel to the batholith boundary and therefore were not reoriented.

In summary, our analysis of the deformation along the boundary between the Vermilion Granitic Complex and the Vermilion district indicates that the two terranes have seen a similar deformation history since the earliest stages of folding in the area. Despite this common history, variations in structural style occur between the two terranes, such as the relative development of D_1 fabrics and D_2 shear zones, and these can be attributed to differences in the crustal levels of the two terranes during the deformation. Similarly, the local development of F_3 folds in the VGC, but not in the Vermilion district, is interpreted to be a result of late-D_2 pluton emplacement which was not significant at the level of exposure of the Vermilion district.

References:

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