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Influence of melt induced mechanical anisotropy on AMS fabrics and rheology of deforming migmatites, Central Vosges, France,

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In the Central Vosges (Vosges Mts., France), felsic anisotropic orthogneiss domains, immersed in homogeneously flowing viscous diatexites deforming by non-coaxial weakly constrictional flow, are exposed. These domains show a structural and anisotropy of magnetic susceptibility (AMS) zonation associated with an increasing amount of melt from the core to their margins. An original AMS fabric is preserved in the core of the orthogneiss domains where the granite veins were emplaced along a dilated mechanical anisotropy. The internal margin of orthogneiss bodies exhibits the development of a prolate AMS fabric and the active buckling of an orthogneiss/granite multilayer. The external margin of the orthogneiss bodies is characterized by oblate AMS fabrics resulting from a layer perpendicular shortening of a melt-orthogneiss multilayer, pinch-and-swell structures and extensional kink bands along which granite veins have been injected. The surrounding metasedimentary migmatites show a similar structural history but the degree of fabric resetting is significantly higher. This systematic fabric and structural succession is due to continuous evolution of rheological relations between the refractory orthogneiss and the fertile metasediments during progressive melting and continuously evolving degree of mechanical anisotropy in the stronger orthogneiss. Detailed microstructural study shows that the AMS fabric is controlled by diffusion creep in the matrix and passive rotation of biotite in weakly molten rocks and by particulate flow in high molten orthogneiss. The study is complemented with the AMS numerical modelling that confirms a complex evolution in

deforming migmatites in refractory orthogneiss. We suggest that migmatites cannot be regarded as simple solid rock–granite vein systems characterized by pervasive melt migration but as mechanically complex systems with transient rheology and mechanical anisotropy related to progressively evolving melt proportion and rheological contrast between fertile and refractory lithologies. In addition, the transient rheological properties of both the orthogneiss/melt multilayer and the surrounding progressively melting metasediments may explain the relatively high deformation coupling between these two rock types.