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Evidence that viscous shear zones spontaneously establish hydro-mechanical anisotropy

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We revisit large shear strain deformation experiments on Carrara marble and observe that anisotropic porous domains develop spontaneously during shearing. Specifically, as samples are deformed periodic porous sheets are documented to emerge and are found to transfer mass. These results imply that viscous shear zones may naturally partition fluids into highly anisotropic bands. As this hydro-mechanical anisotropy is produced by creep, each porous sheet is interpreted to represent a transient dynamic pathway for fluid transport. It is unclear how long each porous domain is uniquely sustained but it is clear that sheets are persistently present with increasing strain. Our results forward the idea that viscous shear zones have dynamic transport properties that are not related to fracturing or chemical reaction. We believe these new results provide experimental foundation for changing the paradigm of viscosity in rocks to include dynamic permeability. In our view making this change in perspective could alter many classical interpretations in natural banded mylonite zones, for example shear zone parallel syn-kinematic veining may be the result of pore sheet instability and ductile fracturing.