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Dynamics of tectonic nappes: Extended thin sheet approximation and effective strength of the lithosphere under simple shear

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We derive depth integrated equations able to capture the nappe formation. Nappes represent first order features in most mountain belts. They are thin (km-scale) slices of the crust exhibiting large (100km-scale) horizontal displacement relative to their underlying units. They bring high grade rocks and their PTt record towards to the Earth surface. Existing depth integrated models capture lithospheric thickening and flexure, but kinematically exclude the possibility of the nappe formation solely on the ground of simplicity. We aim at a simple model allowing for spontaneous nappe formation and their large simple shear deformation. We derive an effective strength-like property, similar to yield strength envelopes for thickening or effective elastic thickness for flexure, that is able to quantify lithospheric resistance for nappe formation. We also identiy the driving force, or the 'reason', for the nappe formation under pure shear far-field loading. Tectonic overpressures and shear heating are essential ingredients of our nevertheless simple depth integrated model. We demonstrate that this simple models captures essential features of the complete (not depth-averaged) model.