08.22: Transient evolutionary geomechanical models of fold-and-thrust belt systems

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ABSTRACT

We use forward transient geomechanical modeling to study the pore pressure behavior in fold-and-thrust belt systems. We find that there is significant overpressure generated by tectonic loading (Fig.1a, b) in the wedge. We find overpressure in fold-and-thrust belts grow self-similarly (Fig.2). Both the mean effective stress and the deviatoric stress magnitudes in the wedge are limited by the generated overpressure. Compared to the drained case, sediment in the wedge has much higher porosity at equivalent depth (Fig.1c). When overpressure is high, although the total porosity loss is smaller, a larger fraction of the porosity loss results from shear-enhanced compression. Overpressure increases as the tectonic loading rate increases and as the mudrock permeability decreases.

CLICK ON IMAGE FOR LARGER VIEW

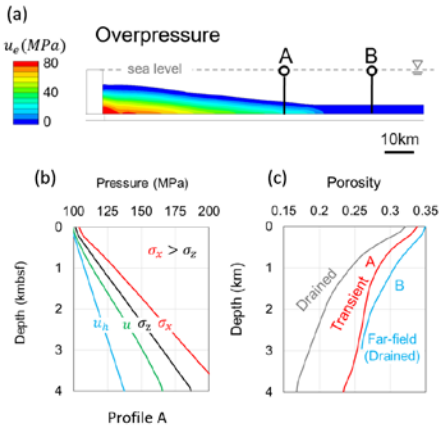

Fig.1: Pressure, stress, and porosity of fold-and-thrust belt from geomechanical modeling.

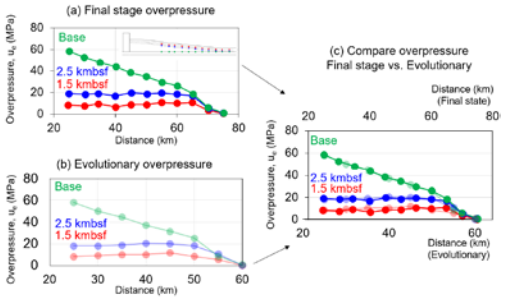

Fig.2: Overpressure distribution and overpressure evolutionary behavior.

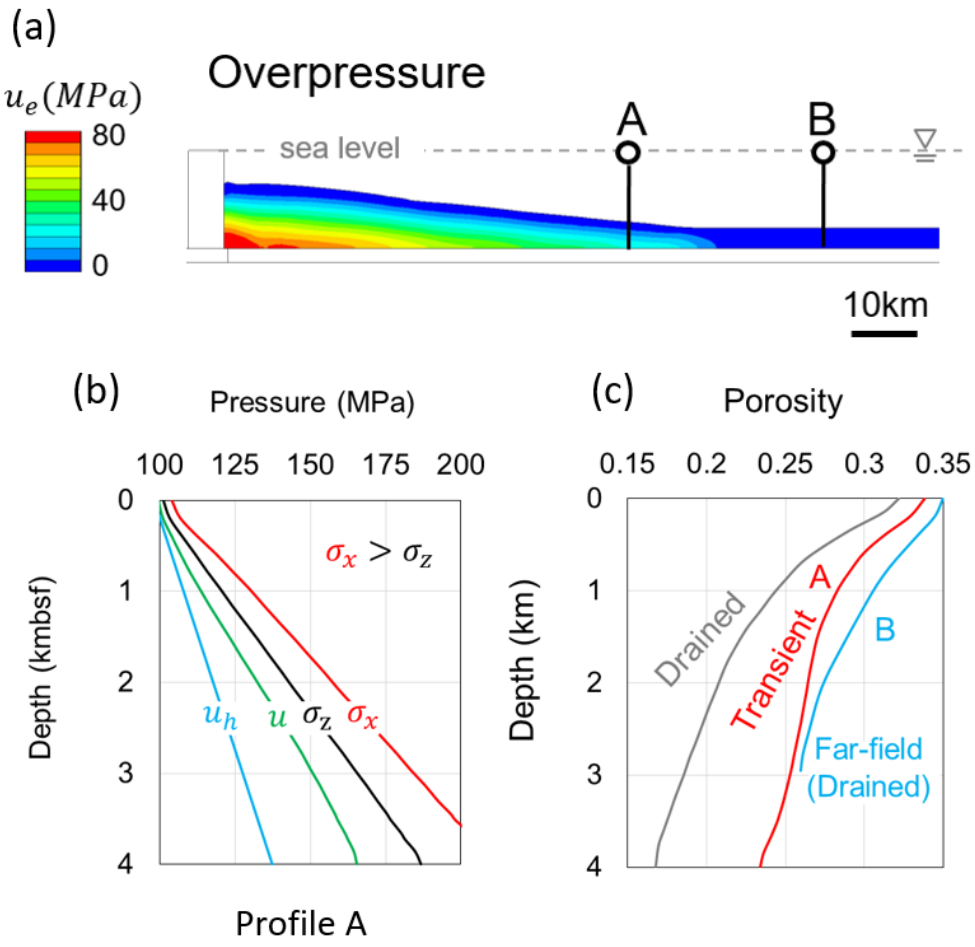

Fig. 1: Pressure and porosity results from transient geomechanical model. (a) Excess pressure distribution. (b) Pressure plot. The cyan, green, black, and red lines are hydrostatic pressure, pore pressure, overburden stress, and horizontal stress respectfully. (c) Porosity profiles. Grey: porosity from drained model. Red: porosity of profile A. Cyan: porosity of profile B.

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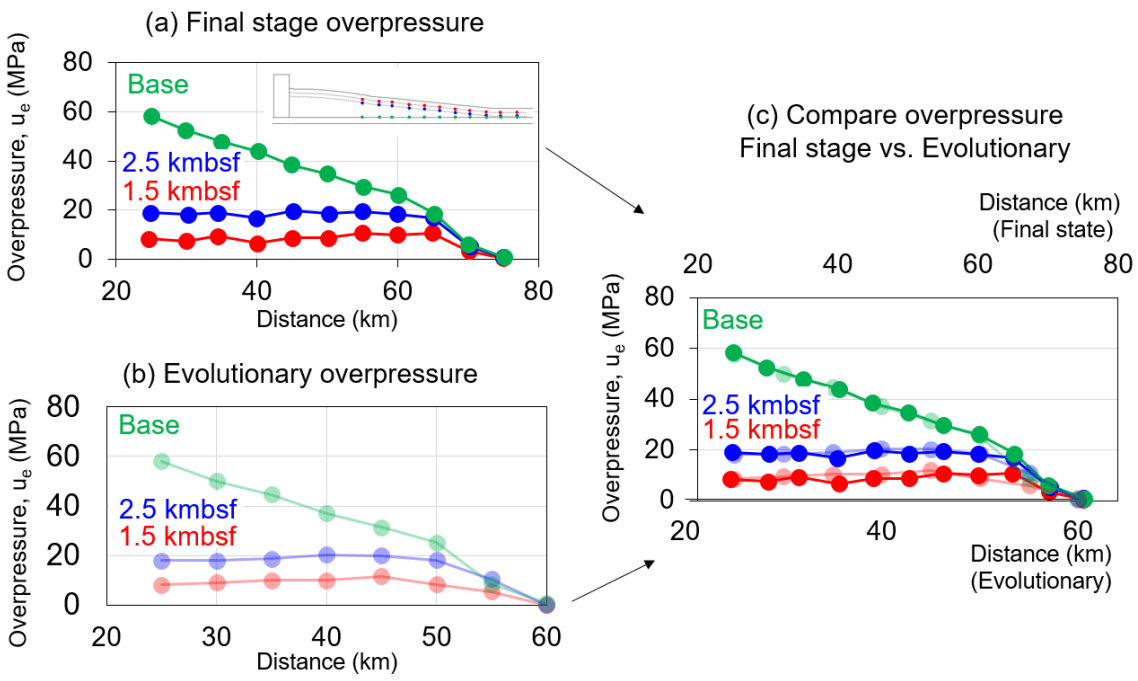

Fig. 2: (a) Overpressure distribution at final stage. Red, blue, and green symbols represent overpressure at 1.5km below sea floor, 2.5km below sea floor, and along the base of the decollement. (b) Evolutionary overpressure values at 8 stages. (c) Compare the overpressure at final stage (solid color symbols) to the evolutionary results (light color symbols). Both the pattern of the overpressure increase and the overpressure magnitudes are consistent, which indicate the overpressure in the fold-and-thrust belts grow self-similarly.

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