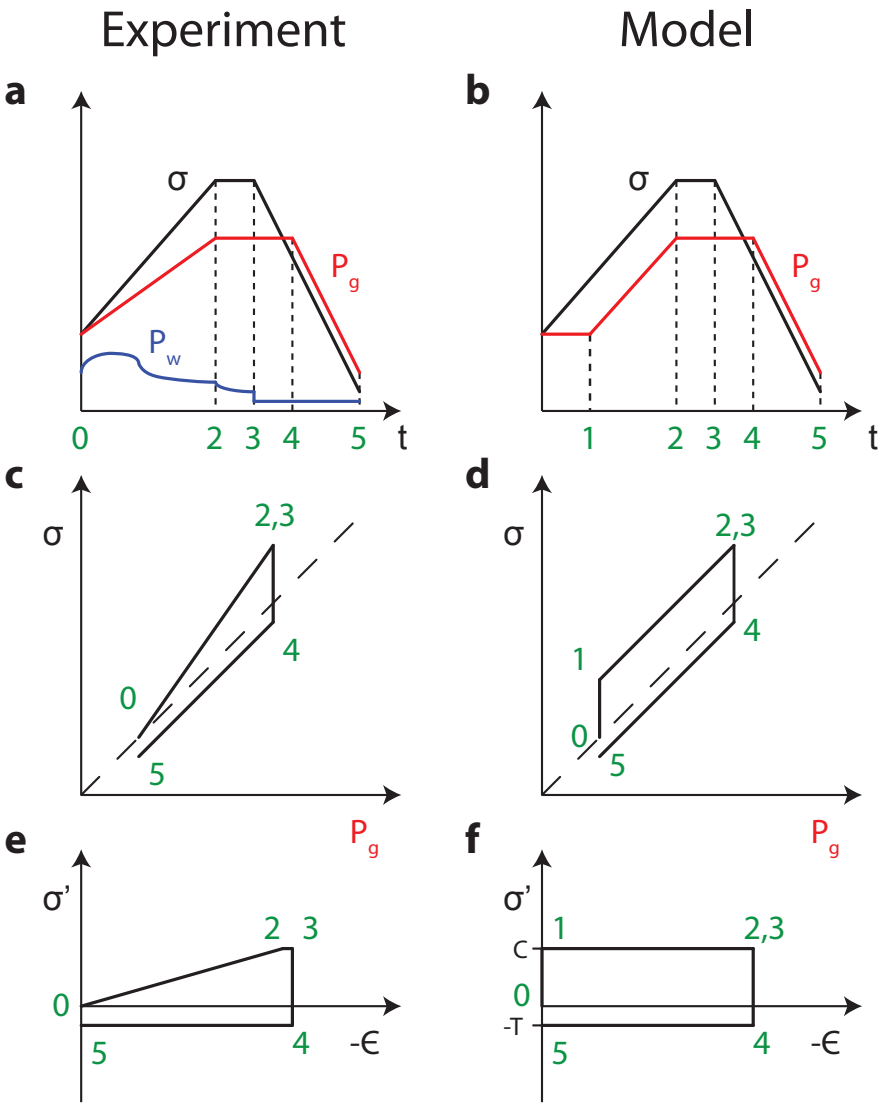

Figure S1: Idealizations of pressure, stress and strain responses of gassy sediments over a uniaxial loading-unloading cycle. Panels (a, c) and (e) show the simplified results from drained experiments by *Sills et al.* [1991], and (b, d) and (f) demonstrate the model response to the same input. (a-b), time series of total stress (black), gas pressure (red), and water pressure (blue). The six time indices in green correspond to (0) the initial condition, (1) beginning of plastic cavity compression (2) end of loading, (3) beginning of unloading, (4) onset of plastic cavity expansion, and (5) final condition. The pressure (and volume - see *Thomas* [1987]) of gas cavities is insensitive to the water pressure but remains within an envelope of tensile (T) and compressive (C) strength around the sediment stress, showing that the effective stress in this system is $\sigma' = \sigma - P_g$. (c-d), phase plane of stress and gas pressure. (e-f), effective stress versus compressive volumetric strain, $-\epsilon$. Between indices 0 and 2, the experimental results may be interpreted as an increase in compressive strength with compression, or hardening, that is not captured by the model, which assumes C to be a constant function of depth.

References

Sills, G. C., S. J. Wheeler, S. D. Thomas, and T. N. Gardner (1991), Behavior of offshore soils containing gas bubbles, *Geotechnique*, *41*(2), 227–241.

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