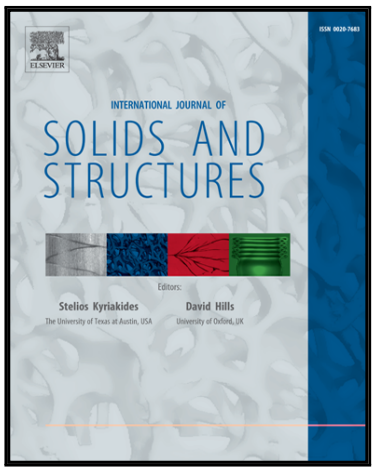


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# A chemo-elastic-plastic model for unsaturated expansive clays

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**Abstract**: Clays are widely used as sealing materials in various geotechnical and geo-environmental engineering applications. These clays are usually unsaturated and are sensitive to chemical composition of the saturating solutions. During their service period, various mechanical, chemical, and hydraulic loading conditions, usually coupled with each other, can be encountered. It is necessary to use a chemo-elastic-plastic unsaturated model to account for these coupled loading paths and simulate the possible behaviours of these clays in their realistic engineering context. In this paper, based on the thermodynamic framework (Lei et al., 2014) for unsaturated expansive clays, the chemo-elastic-plastic model developed by Loret *et al*. (2002) for saturated homoinonic expansive clays is extended to the general unsaturated case. From a theoretical analysis, it is shown that this model is sufficient to simulate the typical behaviours under various mechanical, chemical, and hydraulic loading conditions. The model is then validated against available experimental data of oedometer tests concerning purely mechanical and mixed chemo-mechanical loadings under controlled matric suction on reconstituted Boom Clay mixed with $NaNo_3$ solution. Reasonably accurate estimates of quantitative responses of these complex coupled geochemical loading paths can be obtained, thus giving us a preliminary insight on chemo-hydro-mechanical coupled behaviours.

**Keywords**: chemo-mechanical coupling; elastic-plasticity; unsaturated soil; expansive clay; double structure

## 1. Introduction