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A non-tectonic origin for the present day stress field in the sedimentary Paris Basin

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The large scale stress patterns observed in intraplate area is generally considered to result from far-field boundary forces that drive plate tectonics. However, no present day deformation has been detected in the Paris Basin, yet significant deviatoric stresses are measured in limestone formations observed above soft argillite layers encountered in this region at depths close to 500m. Further, the pore pressure measured in the argillite is larger than that measured in the surrounding permeable zones. These observations suggest a presently active source of stress in this sedimentary system. We propose that this stress is not related to tectonics but to pressure solution effects activated by pore pressure transients. These transients develop in the natural fracture system that affects the limestone formations. They are linked to climatic variations and involve periods that range from thousands to hundreds of thousands years. This mechanism generates time-dependent shear stresses in soft formations and explains overpressures observed in the very low permeability argillite. This mechanism may be modeled by different visco-elastic behaviors for the various formations. It outlines the influence of time dependent material properties on the present day stress field. These results imply that the viscoelastic properties of sedimentary formations raise a strong difficulty for extrapolating measured surface deformations to basement rocks in domains of very slow tectonics.