Experimental and numerical evidences of the observation of the Biot slow wave thanks to its electrokinetic conversion

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As originally described by Biot in 1956, seismic propagation in fluid-filled porous media should include two longitudinal contributions: the fast and slow P waves, the latest being commonly referred to as the 'Biot slow wave'. This seismic wave has been seldom observed in natural rocks at laboratory frequencies due to its low amplitude properties and has never been recognized at seismic frequencies due to its diffusive properties. In porous media, a part of seismic energy mayalso be converted into electromagnetic fieldsbya coupling phenomenon of electrokineticnature: the so-called seismoelectric effect. Most seismoelectric studies focus on the observation of co-seismic or depth-converted electric fields generated bythe propagation of fast P-waves, mainly to detect or to image new physico-chemical contrasts. Based on Pride's theory (1994), numerical modeling of seismo-electromagnetic wave propagation suggests that the observation of the Biot slow wave could be boostedby its electrokinetic conversion, i.e. that it would be easier to record the electric fields accompanying Biot slow waves generated by a mechanical source rather than the seismic fields. In order to confirm these numerical predictions, we designed a specific laboratory experiment involving a silica sand tank excited by using a homemade pneumatic seismic source. The investigated frequency range [0.5-5kHz] contains the Biot (transition) frequency separating the diffusive from the propagation regimes of the slow wave.Numerical seismoelectromagnetic experiments were also performed at this scale to compute the seismoelectric response in homogeneous and partially saturated sand with this acquisition configuration. The comparison of these experimental data to numerical results provides new perspectives for the detection, study and potential use of the Biot slow wave.