**Supplementary Information**

**Poroelastic and viscoelastic properties of soft materials determined from AFM force relaxation and force-distance curves**

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1. **Elastic properties of cells**

The elastic properties of cells can be determined by fitting equation (1) on the approach part of force-indentation curves, by taking into account or not the cell height. In this equation, the only adjustable parameter is the elastic modulus (*E*) of the probed cell. Supplementary Figure S1A shows two representative experimental curves with the obtained fits of equation (1) by the least-squares method, characterized by *E* values of 1.2 kPa and 0.7 kPa by considering the measured cell thickness of ~3 µm (at the FDC location). All the obtained *E* values on the cytoplasmic regions of cells are gathered in the boxplot representation with mean values of 1.2 ± 0.3 kPa (values comprised between 0.8 kPa and 2.1 kPa) and of 0.8 ± 0.3 kPa (between 0.5 kPa and 1.5 kPa) for semi-infinite and finite-thickness models, respectively (Supplementary Figure S1B). These results also highlight the need to take into account the cell thickness to avoid overestimation of the extracted mechanical parameters, like the elastic modulus. However, such analysis seems only pertinent when FDC hysteresis (revealing the presence of energy dissipative processes) is weak indicating that the elastic modulus values deduced from fitting on approach and retraction parts should be close (Sanchez et al., 2021). Indeed, in the contrary case, elastic properties represent only a part of the mechanical properties that have to be completed by characterizing the dissipative component.



Supplementary Figure S1: (A) Experimental force-indentation curves with the fitting curves obtained by adjusting the elastic model on the approach part by the least-squares method. (B) Boxplot representation of the elastic modulus values obtained by using the elastic model either with an infinite cell thickness (semi-infinite model) or the measured cell thickness (finite-thickness model).

1. **Generalized Maxwell model applied to cells**

The viscoelastic nature of time-dependent responses of fibroblast cells offers the ability to use various viscoelastic models to analyze their dissipative processes. In this way, to determine relaxation times associated to these processes, the generalized Maxwell model, where several Maxwell elements composed by a spring (elastic) and a dashpot (viscous) in series are connected in parallel, was applied to force relaxation curves. Best fits of these curves were obtained with two relaxation times (by adjusting the five parameters by the least-squares method (*E∞*, *E1*, *τ1*, *E2*, *τ2*) of equation (8)), as shown in Supplementary Figure S2A, indicating that two distinct relaxation processes occur after indenting the cells. Indeed, the Maxwell model with a single relaxation time was not able to correctly describe the measured relaxation behavior (Supplementary Figure S2A). However, by zooming in the experimental decay within the first second, best Maxwell fits with two relaxation times did not correctly describe the relaxation behavior of cells (Supplementary Figure S2B). Contrary to viscoelastic hydrogels, it results that the generalized Maxwell model was not able to finely interpret the experimental relaxations, neither by considering a single exponential (*i.e*. single relaxation time), nor with double exponential (*i.e*. two relaxation times) (Cuenot et al., 2022). Therefore, the viscoelastic relaxation of cells subjected to the AFM indentation does not follow a single or double decreasing exponential law.



Supplementary Figure S2: (A) Experimental force relaxation curve with two fitting curves obtained by adjusting the generalized Maxwell model with one (τ1) and two relaxation times (τ1, τ2) by the least-squares method. (B) Zoom of the obtained results in A for times comprised between 0 and 1 second.

**REFERENCES**

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