

Supporting informations

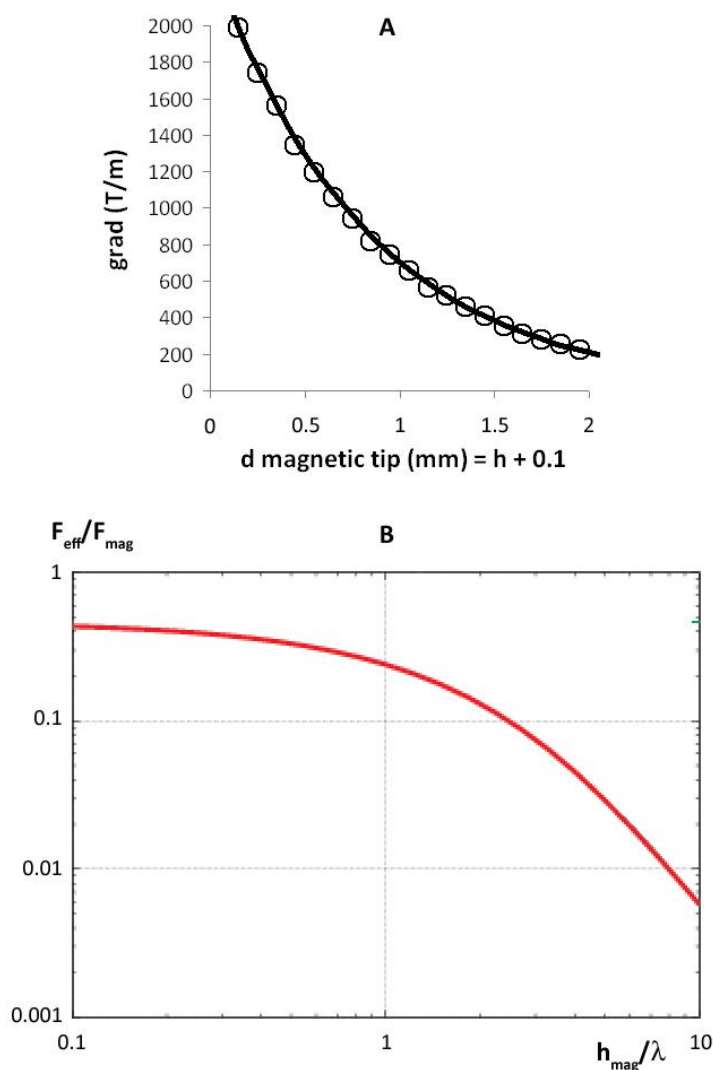


Figure S1: **A:** Magnetic field gradient gradB as a function of the distance to the magnetic tip surface (d magnetic tip) calculated from the trajectories of $1\mu\text{m}$ magnetic beads (Dynal, MyOne). The magnetic gradient can be fitted (plain line) by a simple exponential law, with exponent $\lambda=1.2$: $\text{gradB}(\text{T/m}) = 2390e^{-1.2d}$, d being expressed in mm. At the bottom of the aggregate ($h=0$), $\text{gradB}=2115\text{T/m}$. **B:** Ratio of the effective force seen in the aggregate, F_{eff} , defined in equation 3, over F_{mag} , cellular magnetic force acting on the first layer of the aggregate ($h=0$), as a function of the aggregate height after magnetic compaction (h_{mag}) divided by the exponent λ ($=1.2$ here) of the exponential decay of gradB . This curve was calculated using equation 4 and was used to retrieve F_{eff} for all types of aggregates (h_{mag} being given for each case in table 2).

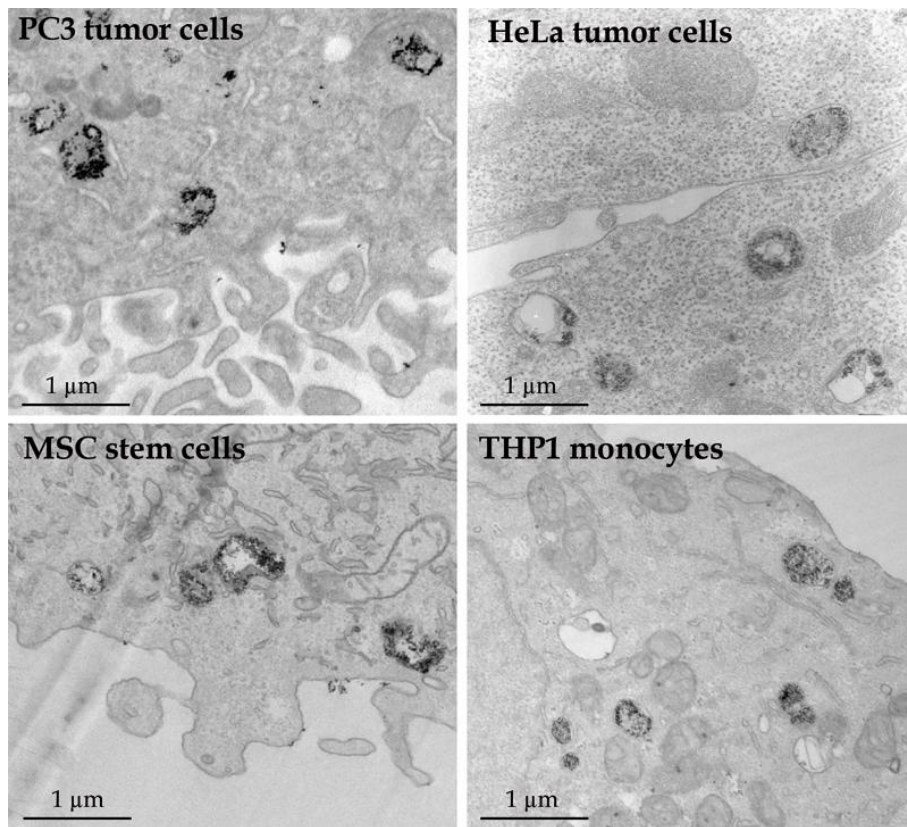


Figure S2: Electronic micrographs of different cell types (PC3 and HeLa tumor cells, MSC stem cells, THP1 monocytes), showing magnetic nanoparticles contained in endosomes.

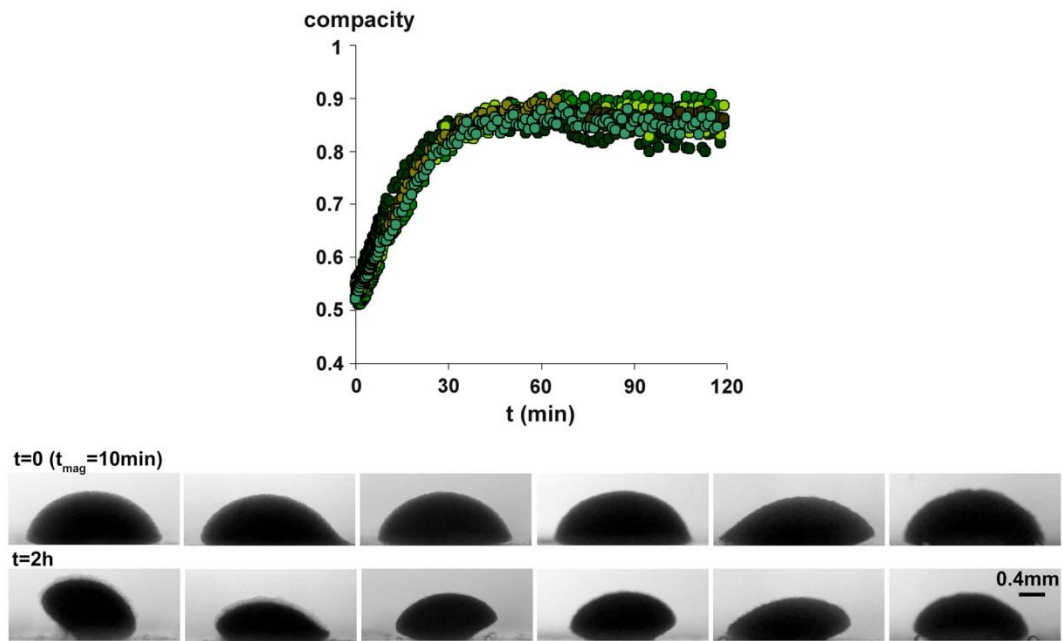


Figure S3: Evolution of the compacity after the removal of the magnet (application time $t_{mag}=10min$), for 5 independent aggregates of HeLa cells. On the right are represented images of the corresponding aggregates at times 0 and 120 min.

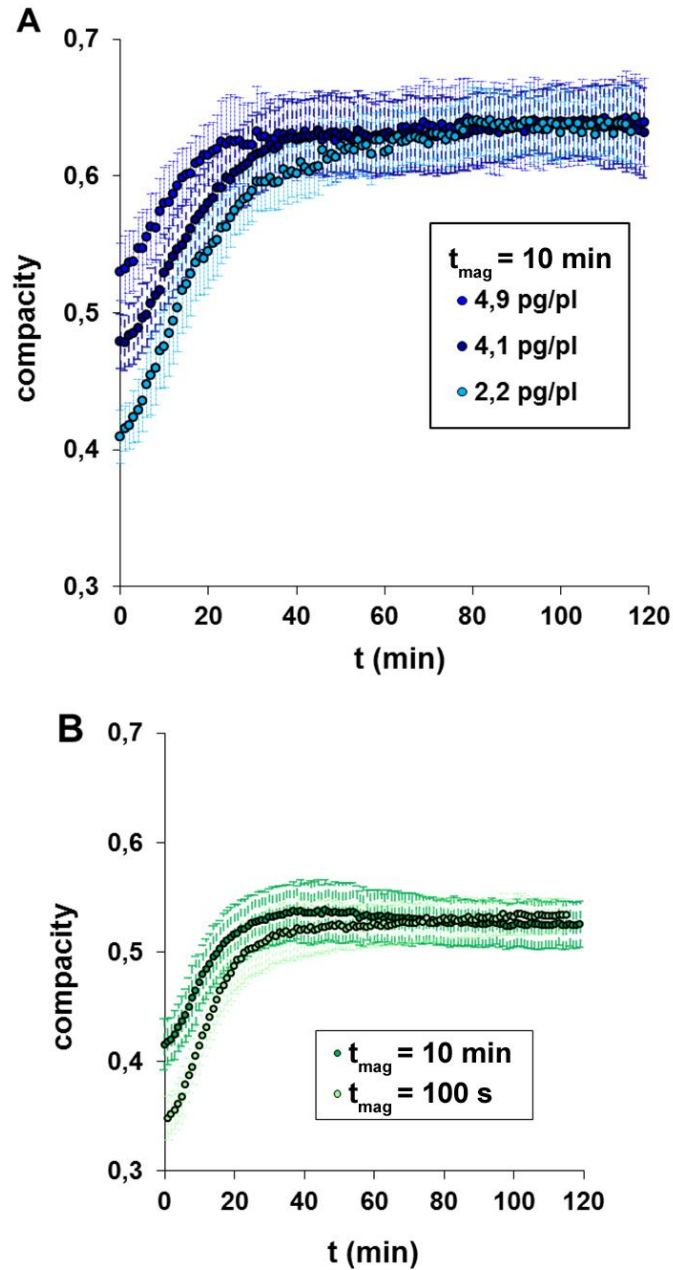


Figure S4: Dynamic changes in aggregates composed of 3T3 fibroblasts (A) or PC3 tumor cells (B). In the case of 3T3 fibroblasts, three cellular magnetic densities were used, yielding increasingly dense aggregates. In all three cases the average compacity observed in three independent experiments reached the same final state $\rho_{\infty} = 0.62$. With PC3 tumor cells, the same magnetic density was used but the aggregates were compacted for 100 s ($\rho_{\infty} = 0.35$) or 10 min ($\rho_{\infty} = 0.41$). Average compacity also reached a final state ($\rho_{\infty} = 0.53$) that was independent of the initial state.

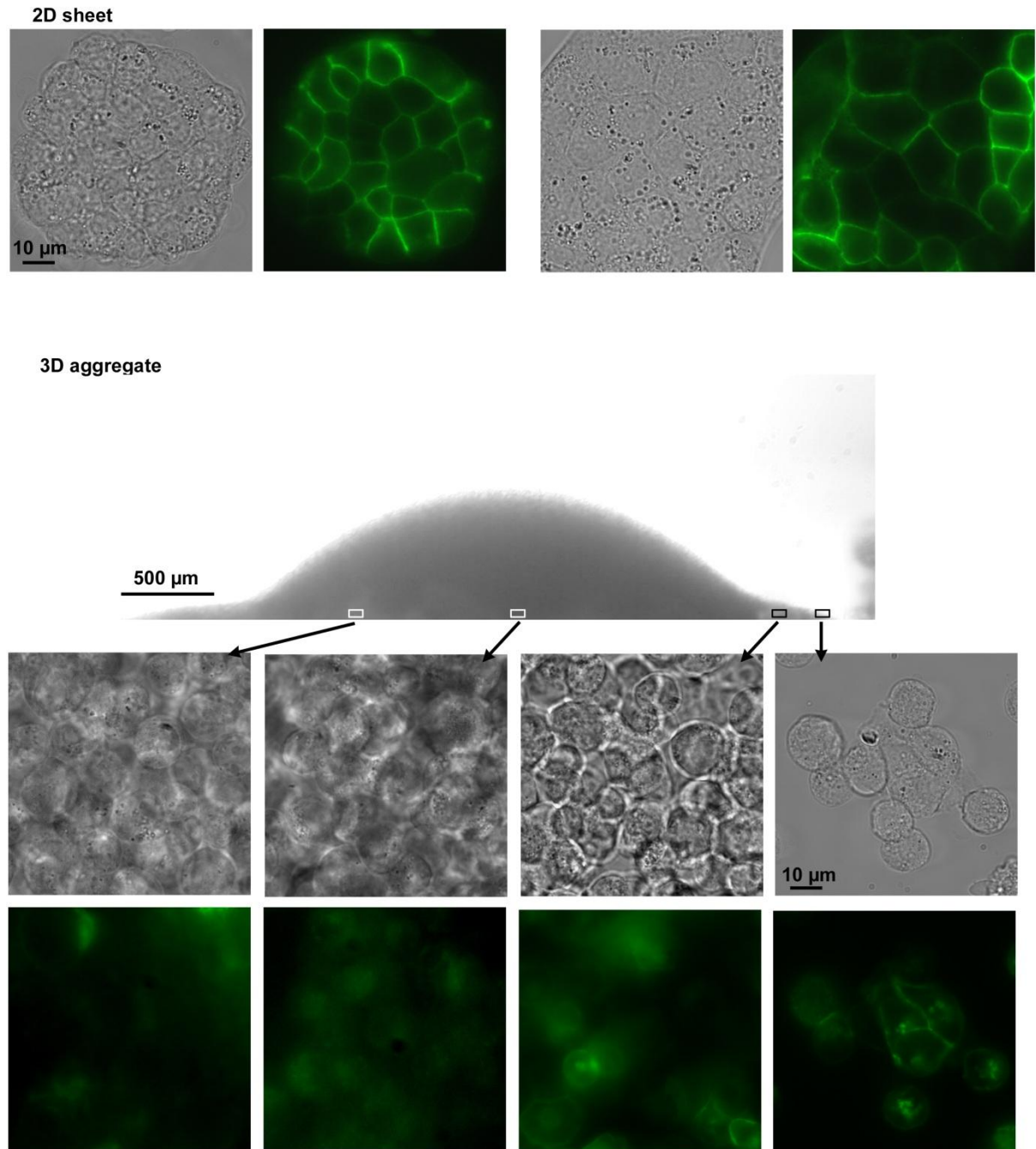


Figure S5: Fluorescence imaging of E-cadherin-GFP-expressing MDCK cells. Top: Cells were seeded in a dish to form 2D sheets, and demonstrate a typical MDCK morphology with tight cell-cell contacts mediated by E-cadherins. Bottom: Cells were magnetically aggregated in 3D (for $t_{mag} = 10$ min), the force was then removed and the aggregate evolved spontaneously for 2 hours. It was then fixed and observed with fluorescence microscopy at different locations : in the center or at the edges. Only the cells that have escaped the aggregate and formed 2D clusters are faceted with E-cadherin cell-cell contacts. By contrast, cells packed in 3D remain spherical and don't adhere one to the other.

Movie S1: Left : Aggregate formation under magnetic force, duration 10 min. Right : Aggregates spontaneous evolution after the removal of the magnet, duration 1h, for all cell types.

Movie S2: Monitoring the cells dynamics with confocal microscopy, from below the aggregate. For THP1 monocytes (left) and S180 sarcoma cells (middle), the cells membrane appear in red (CellMask tag). For transfected Ecadh-GFP 180 cells (right), the membrane are green due to the presence of E-cadherin GFP tagged. Movie duration = 30 min.