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Stress, Drug Resistance, Adhesion: the dark side of the wall

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Stress, Drug Resistance, Adhesion: the dark side of the wall.

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LISBP LABORATOIRE D'INGÉNIERIE DES SYSTÈMES BIOLOGIQUES ET DES PROCÉDÉS

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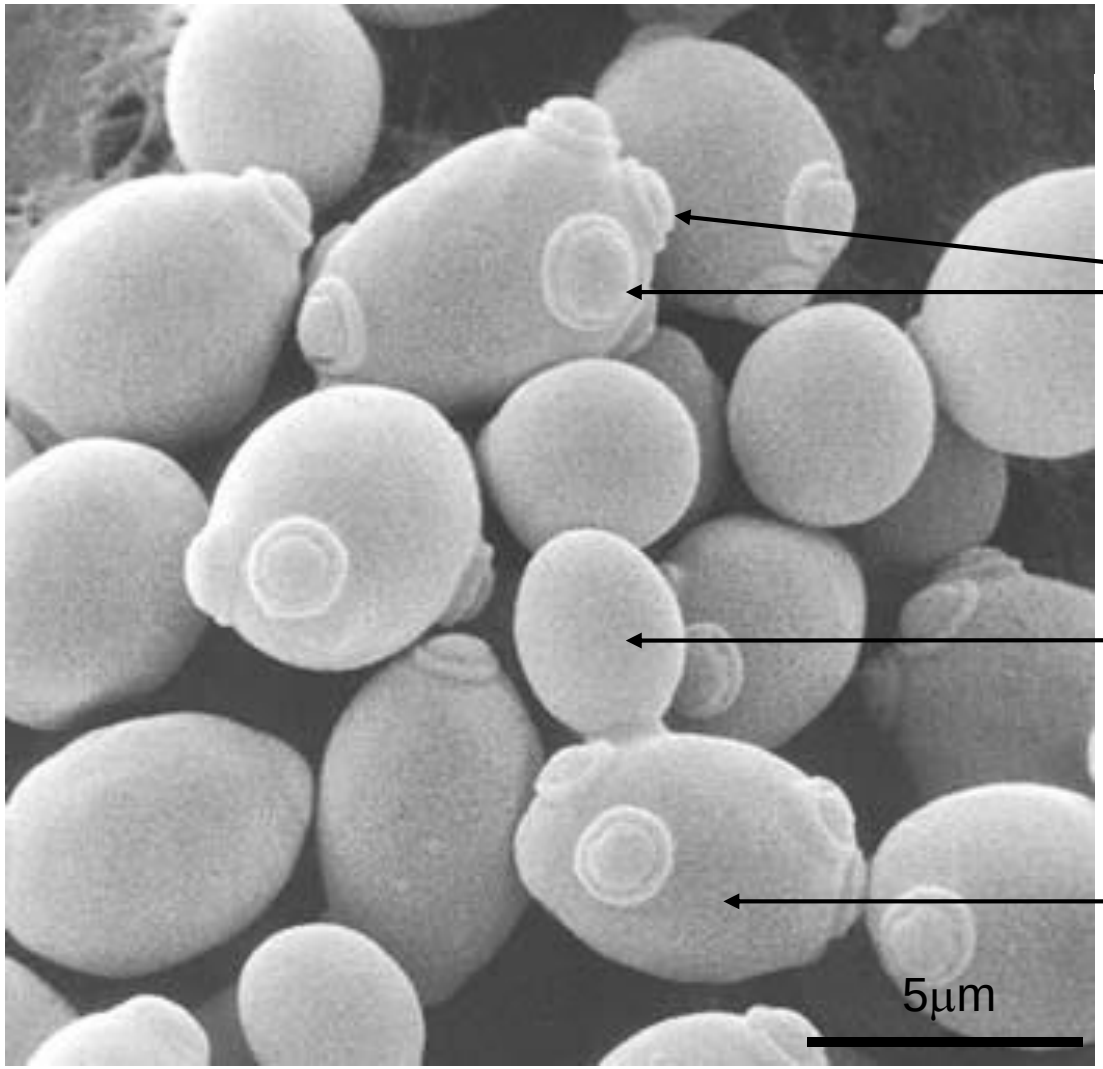
Université de Toulouse

Yeasts



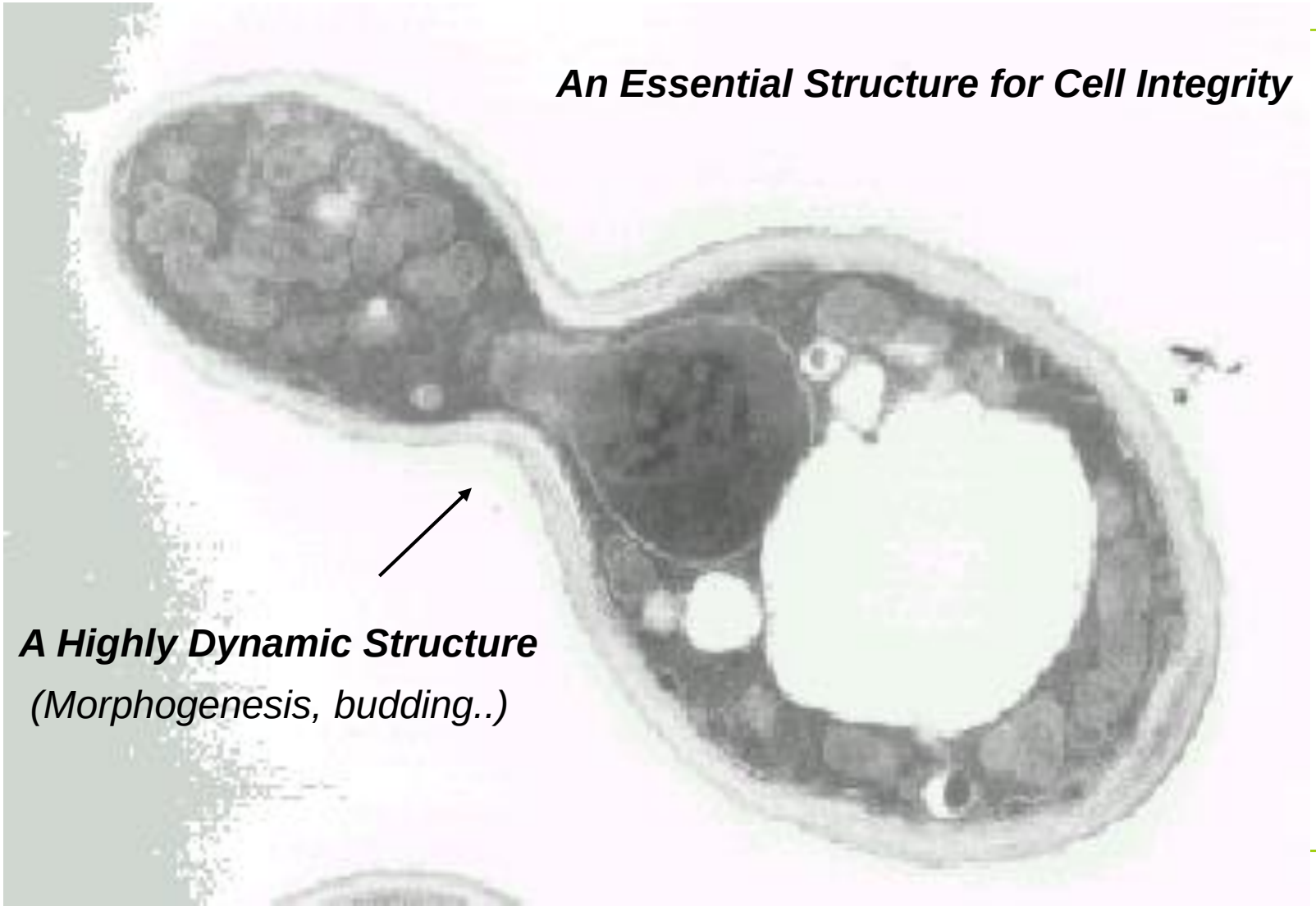
Bud scars

Daughter cell

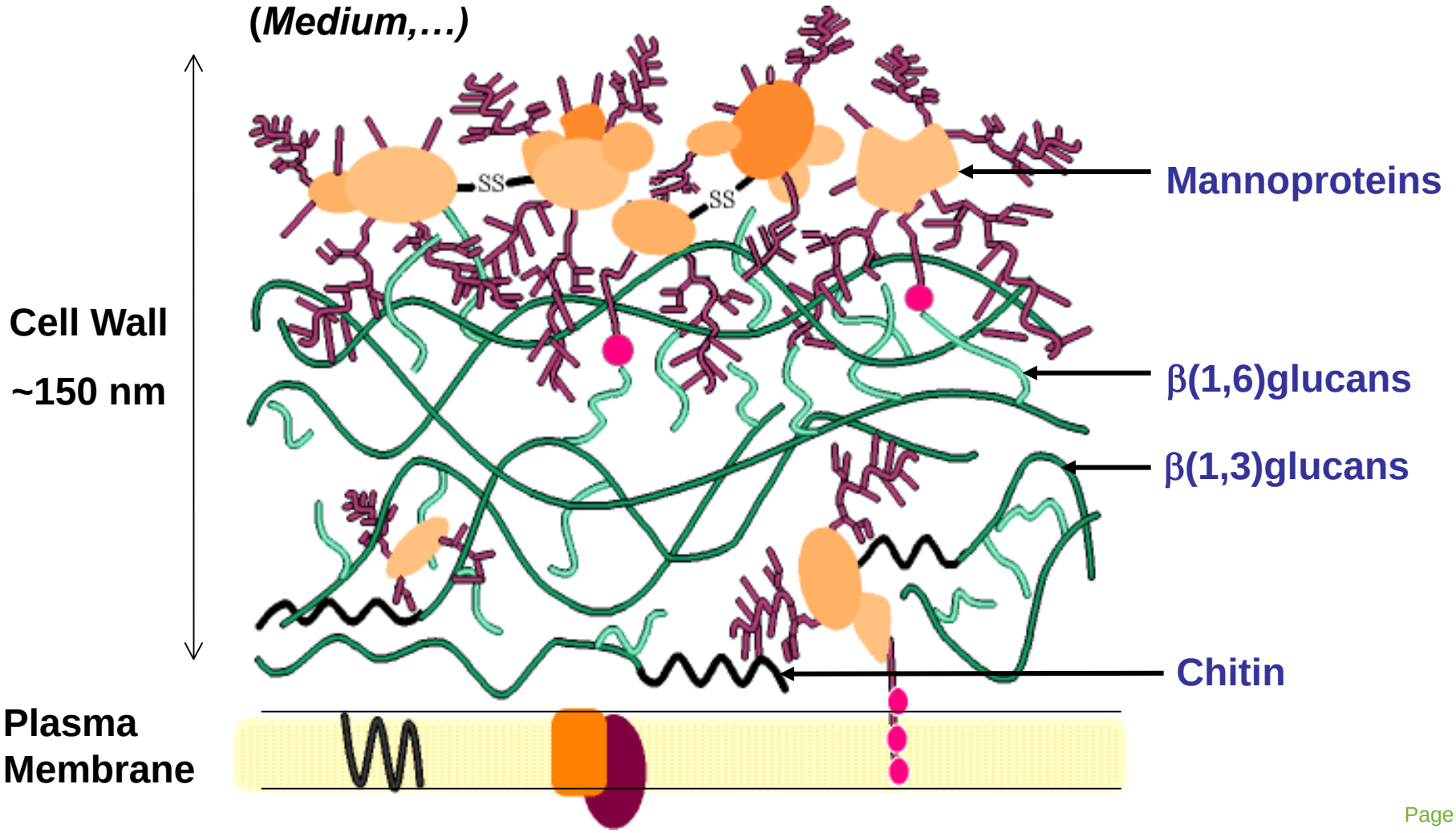
Mother cell

Scanning electron microscope images of yeasts cells (source: Chemistryland.com).

The Yeast Cell Wall



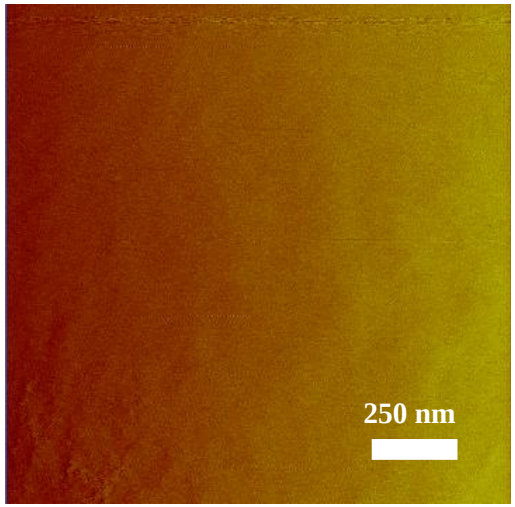
The Yeast Cell Wall Architecture



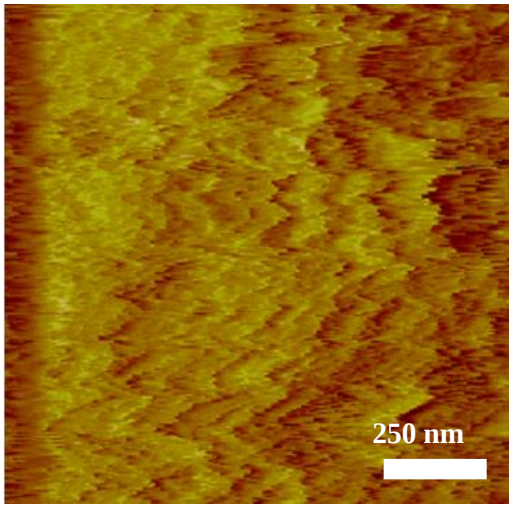
Using

AFM : imaging and nano-mechanics of the cell wall

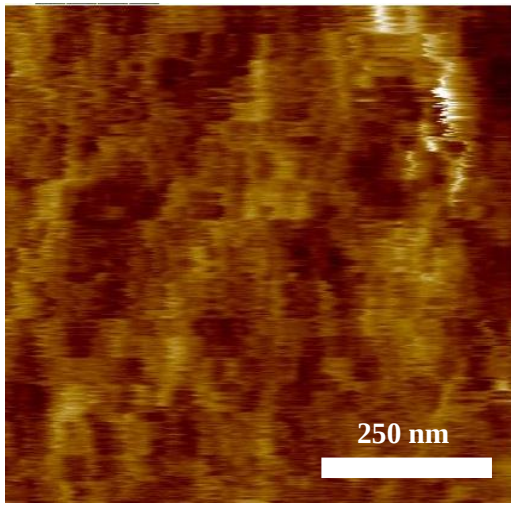
Control strain



mnn9 (affected in mannan synthesis)



fks1 (affected in β-glucan synthesis)



Young's modulus (MPa)	1.62 ± 0.22	1.86 ± 0.58	2.02 ± 0.43
		Elasticity →	***Elasticity*** ↘
Roughness	1.21 ± 0.30	2.95 ± 0.65	5.76 ± 1.8
		Rugosity ↗	***Rugosity*** ↗

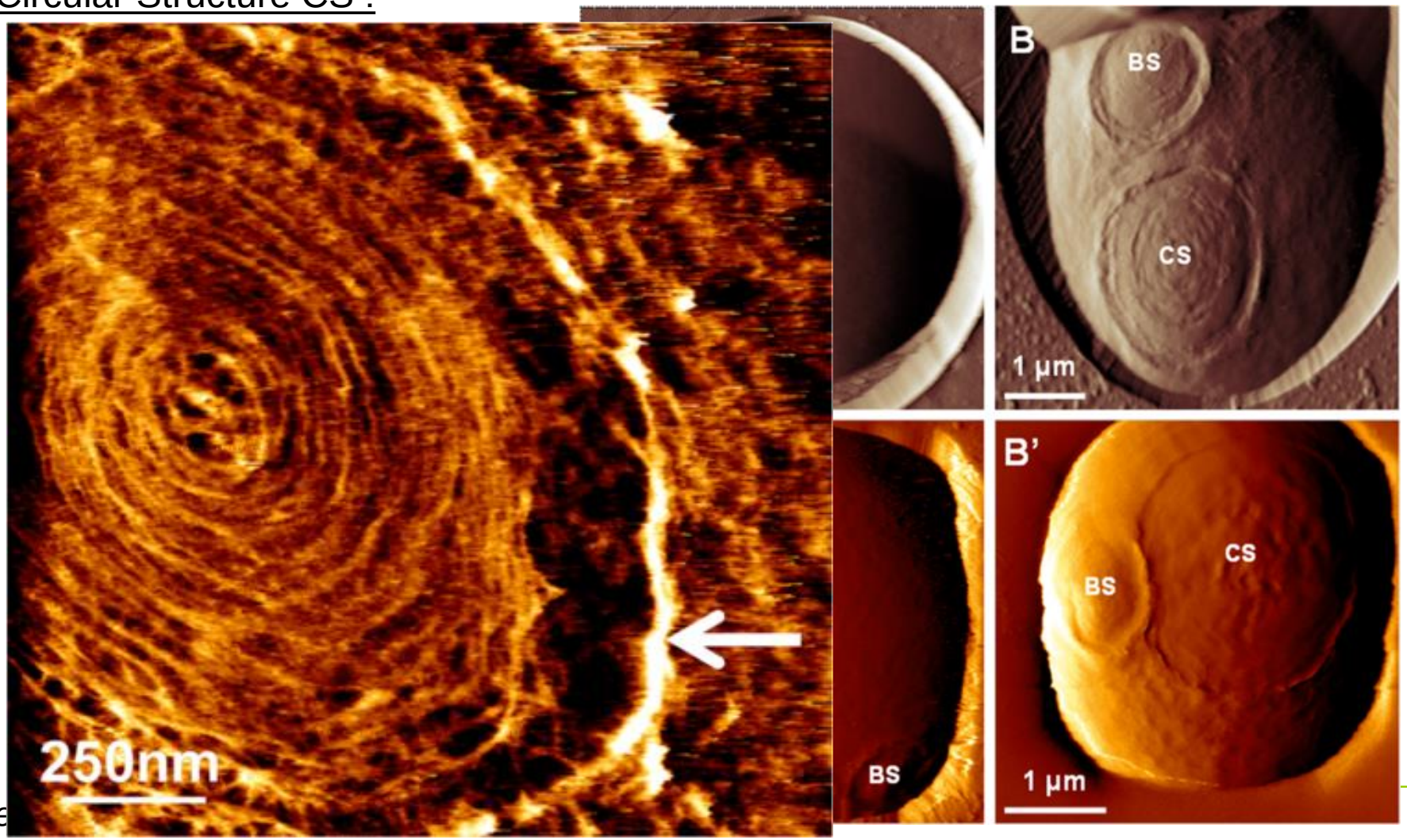
(Dague et al., 2010. Yeast, 27(8), 673-84)

Heat Shock

Ultrastructure of the Circular Structure CS :

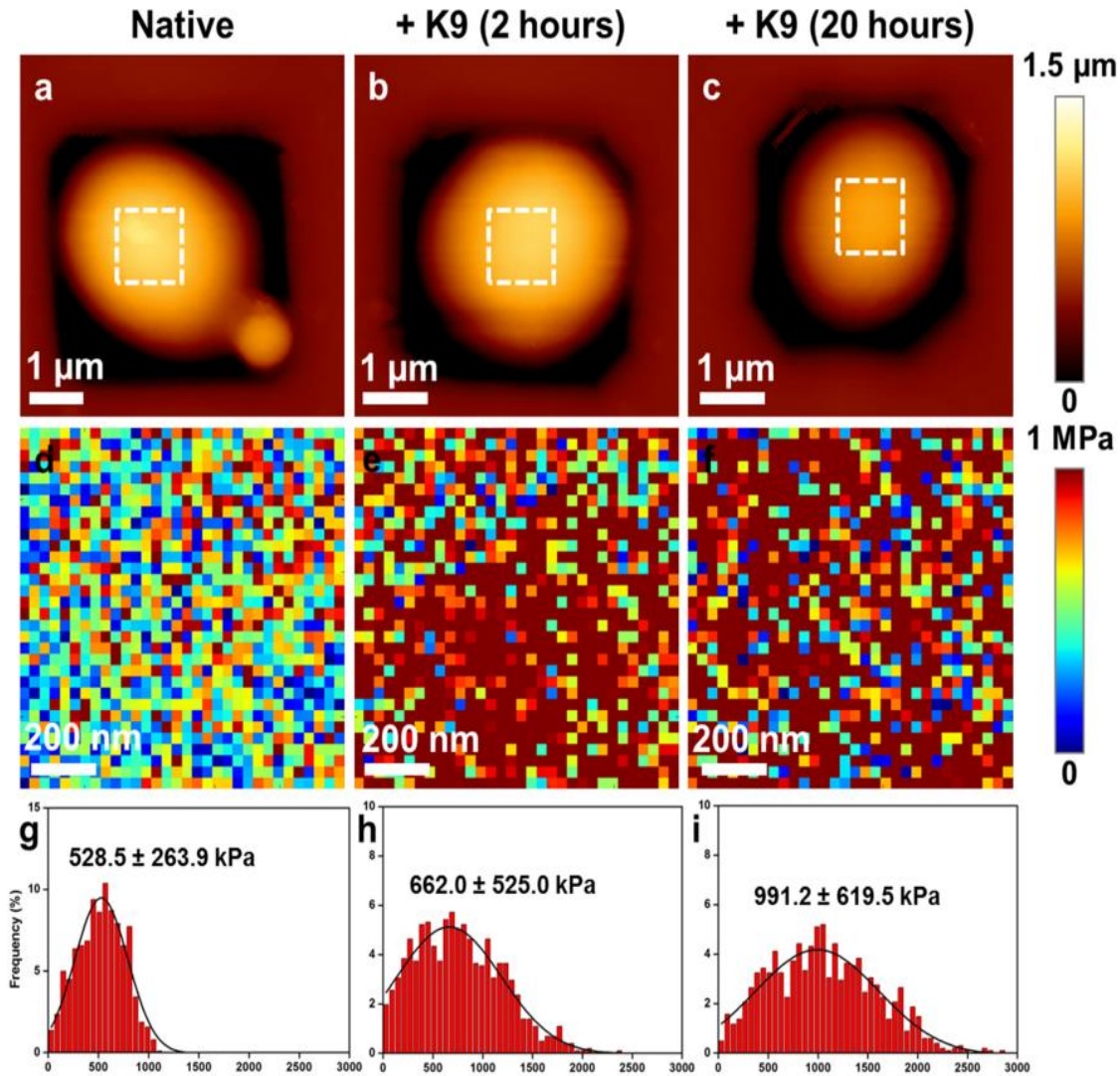
A, A' : unstressed (30°C)

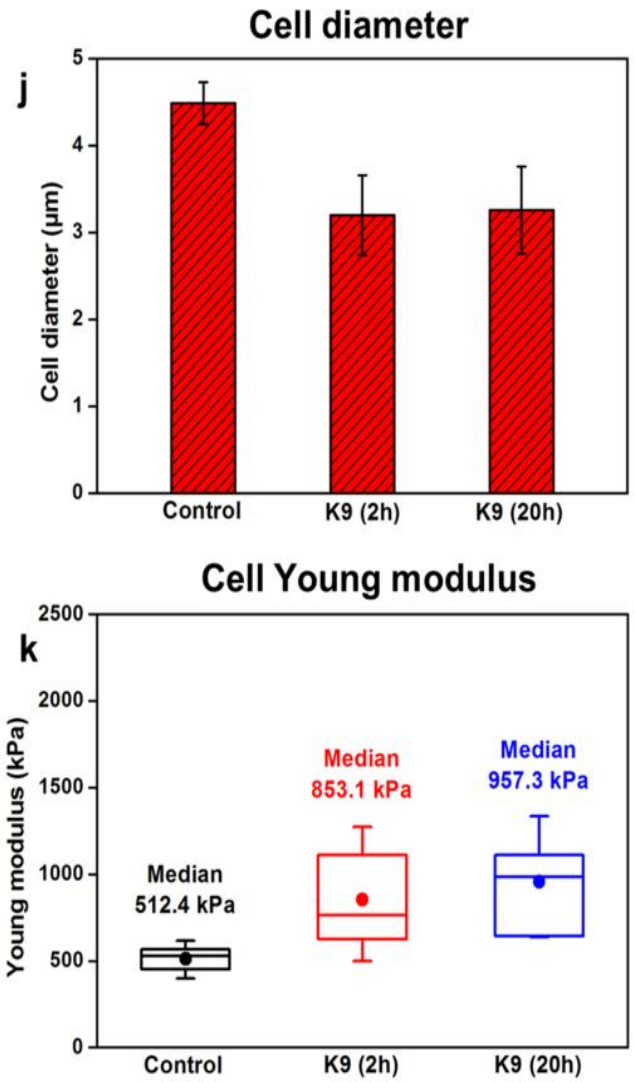
B, B': 1 h at 42°C



(Pille

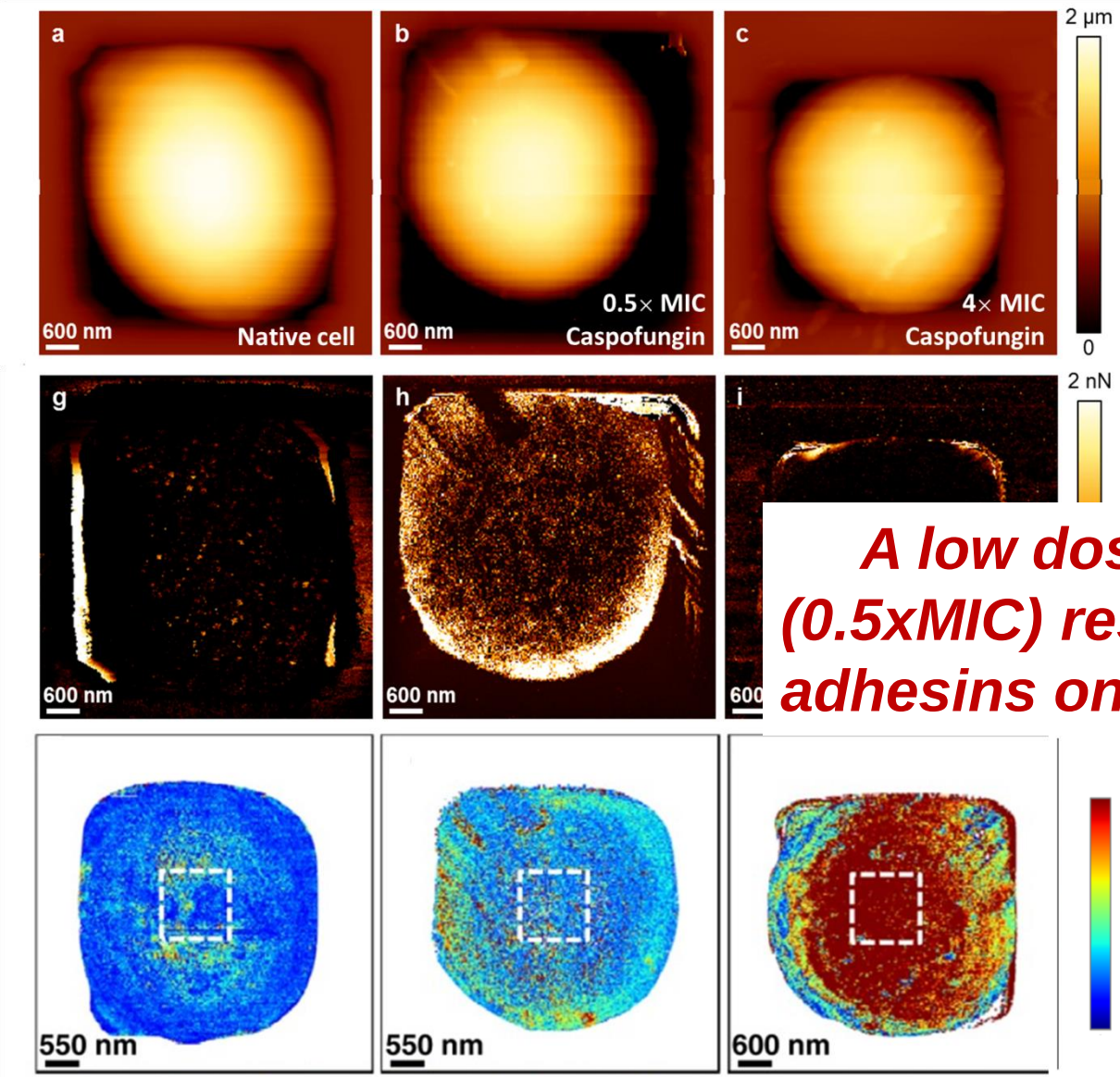
Killer toxin K9





(Liu et al., 2015. Let. App. NanoBioScience, 4 (4), 306-15)

Effect of Caspofungin on C. albicans



Cell's relief
(= 3D Image)

Adhesion Maps

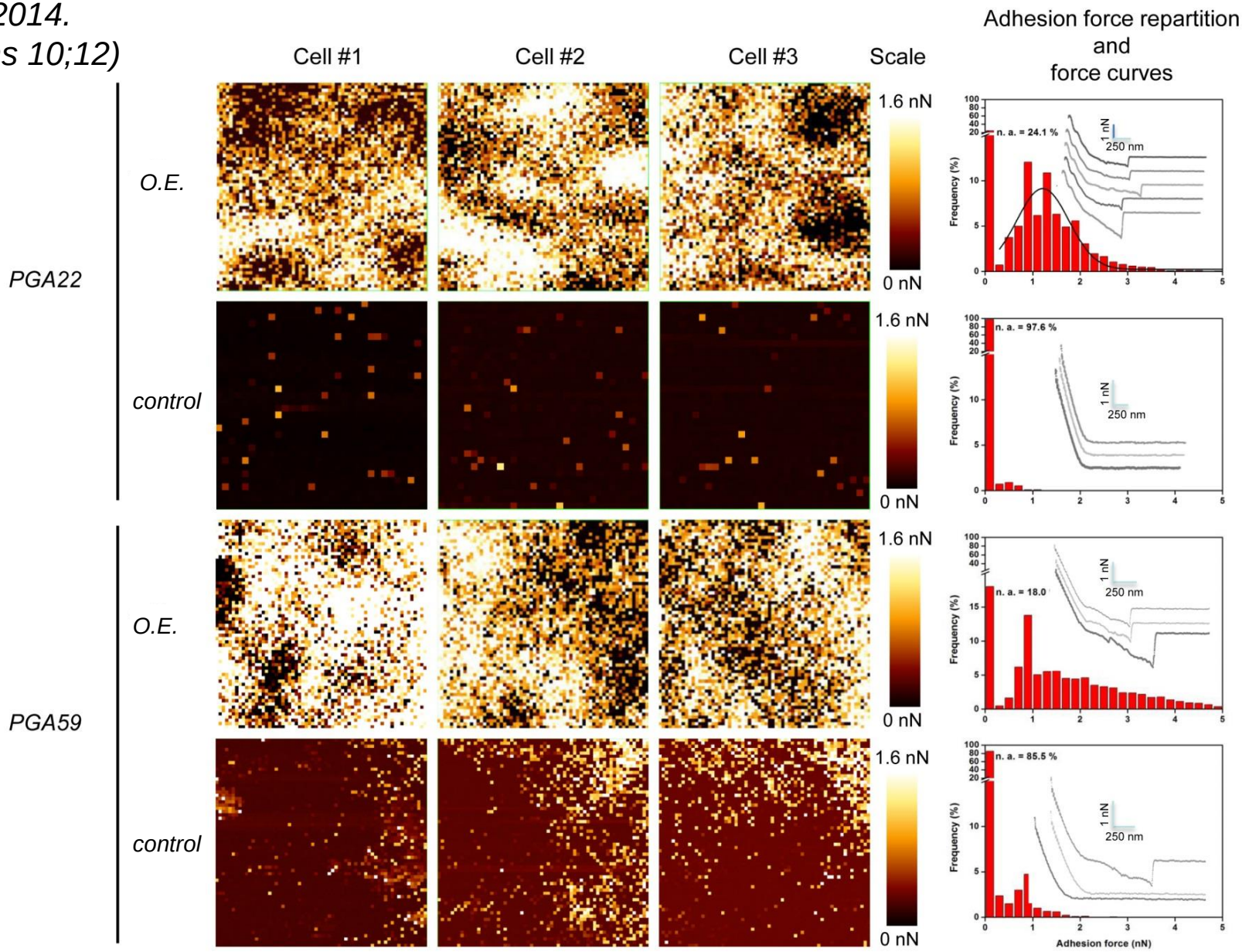
A low dose of Caspofungin (0.5xMIC) results in expression of adhesins on the cell surface !!!

Elasticity maps
(z range = 0.5 MPa)

(Formosa et al., 2013. AAC 57(8))

Single Molecule Force Spectroscopy (SMFS) by AFM to measure cellular Adhesion

(Cabral et al., 2014. PloS Pathogens 10;12)



Perspectives

AFM allowed us to unravel the morphologic effect on yeast cells of Heat Shock, Osmotic Shock, exposure to toxins and drugs.

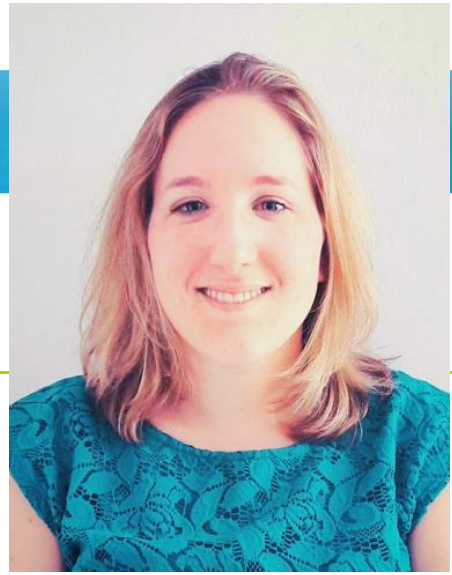
New projects include effect of mycotoxins on yeast cells, and molecular determinants of cell adhesion,

- at the molecular scale with AFM and Optical Tweezers,

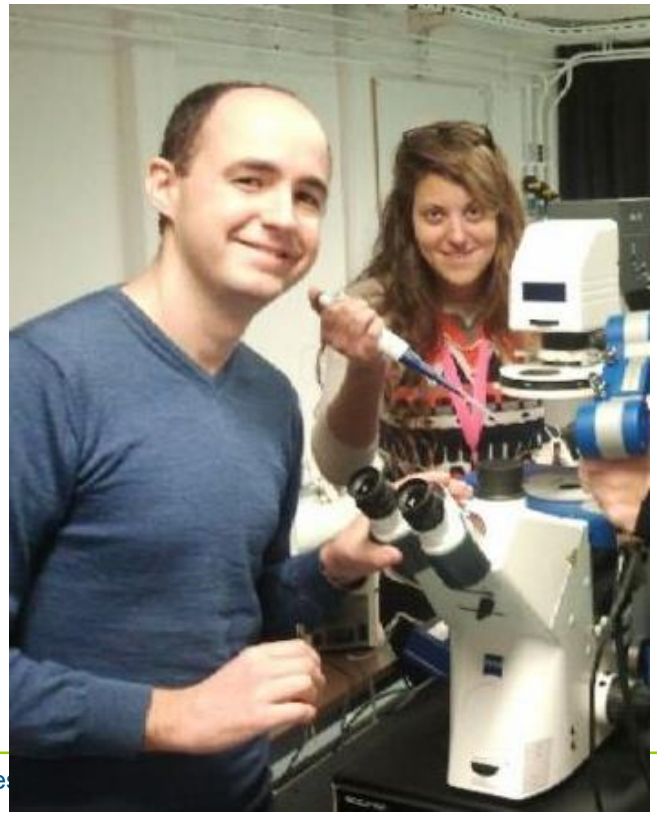
- at the population scale with the Sheer Flow Chamber.

Etienne Dague,
LAAS CNRS

Marion Schiavone,
Lallemand, LISBP



Flavien Pillet,
IPBS

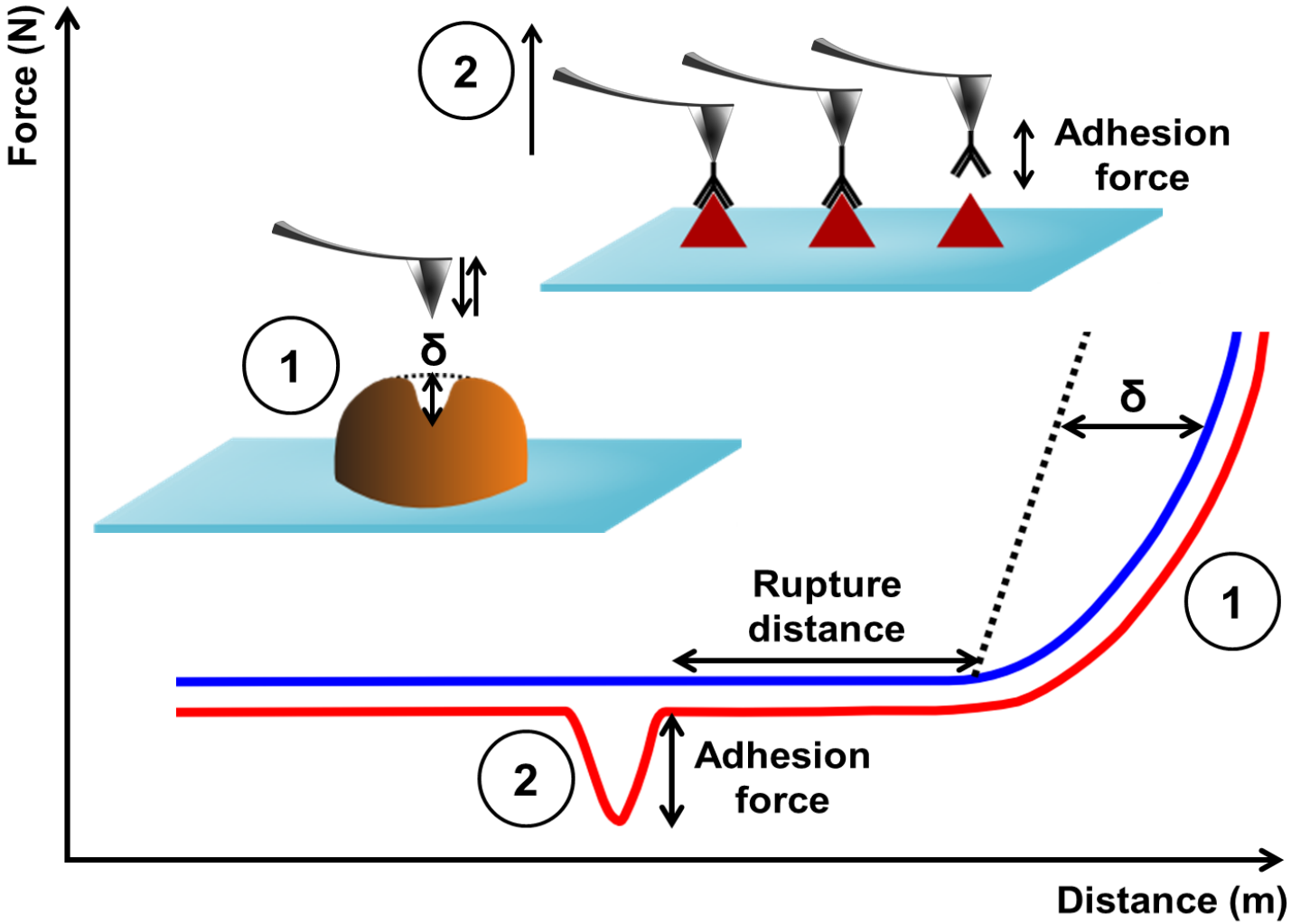


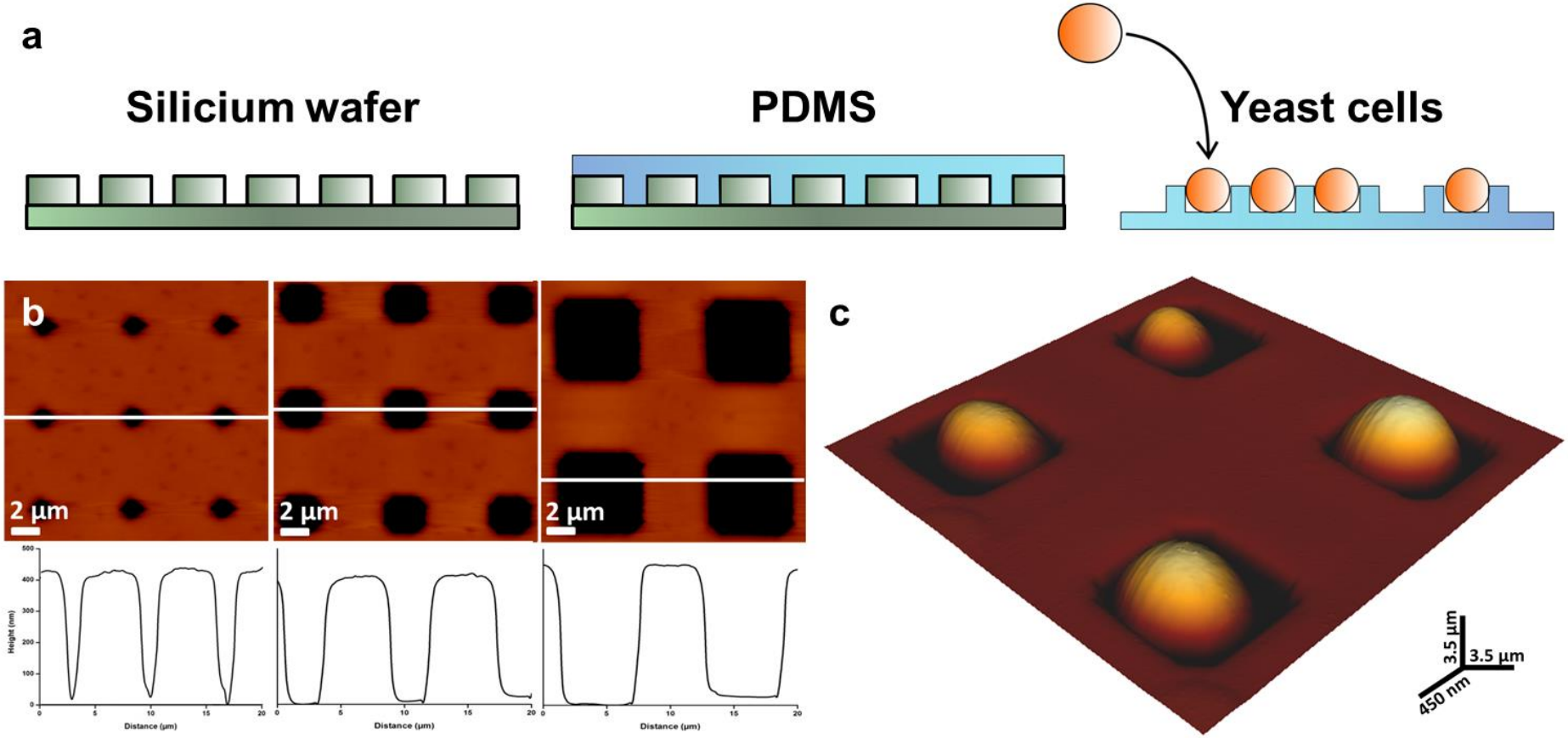
Cécile *Fantastique*
Formosa-Dague,
UCL Louvain la neuve

Pr Jean-Marie François,
INSA

And…
THE FORCE !!!!!

Thank you for your attention !


Force (N)
2
Adhesion
force
1
δ
δ
Rupture
distance
1
2
Adhesion
force
Distance (m)


a
Silicium wafer
PDMS
Yeast cells
b
2 µm
2 µm
2 µm
Height (nm)
Distance (µm)
Distance (µm)
Distance (µm)
c
3.5 µm
3.5 µm
450 nm