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Detection of titanium nanoparticles in human, animal and infant formula milk.

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Detection of titanium nanoparticles in human, animal, and infant formula milk.

The sustainability of mammals on Earth relies on milk. During lactation, maternal exposure to metal nanoparticles (NPs) can affect offspring development and survival. Despite being banned from food applications in Europe due suspected toxicity, titanium dioxide (TiO₂) NPs are still massively manufactured for countless other uses. **While contamination of ecosystems is well documented, contamination of mammals remains underexplored.** Here, we used **synchrotron X-ray fluorescence and single particle inductively coupled plasma mass spectrometry** to analyse human, animal, and infant formula milk.

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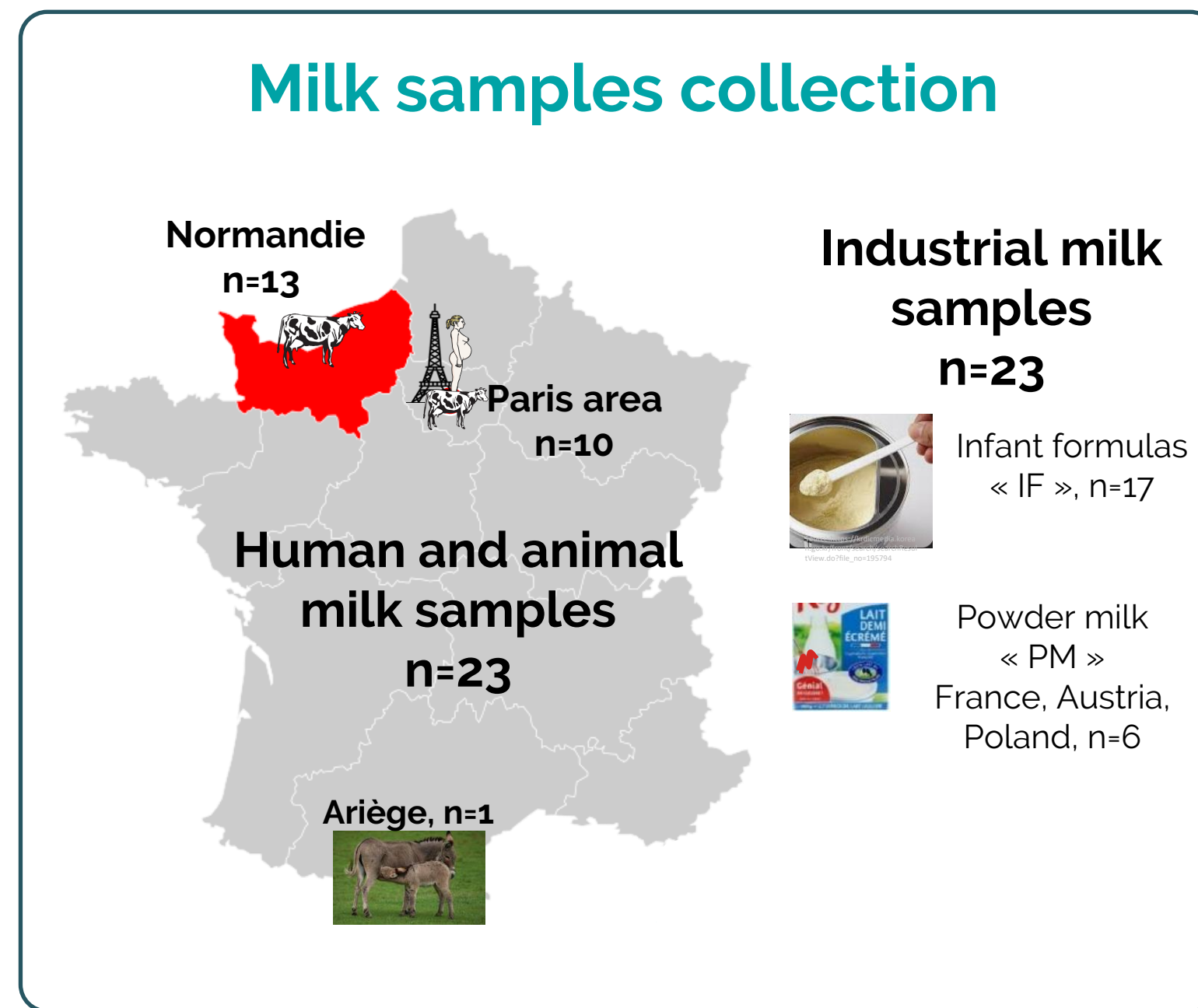
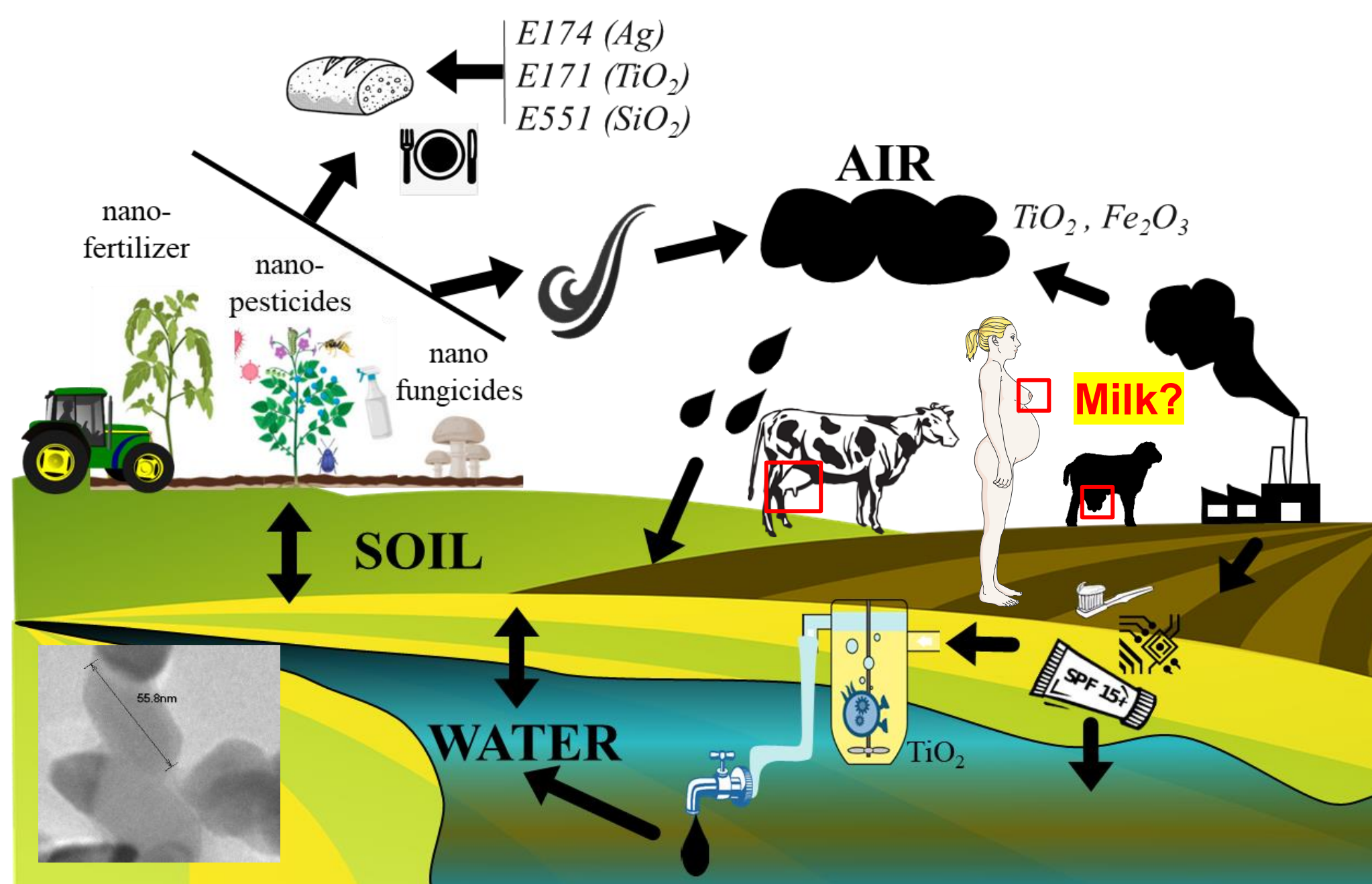
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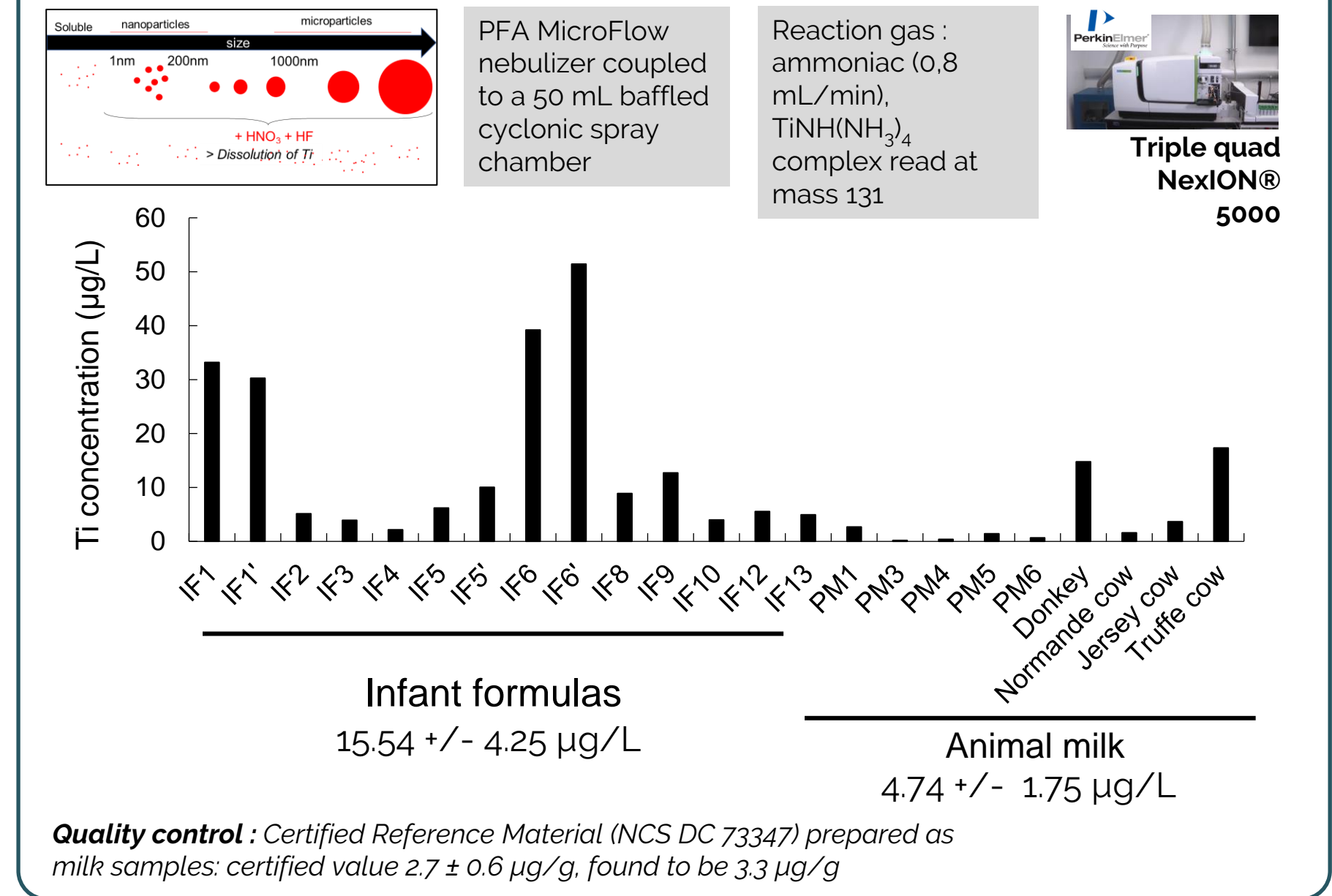
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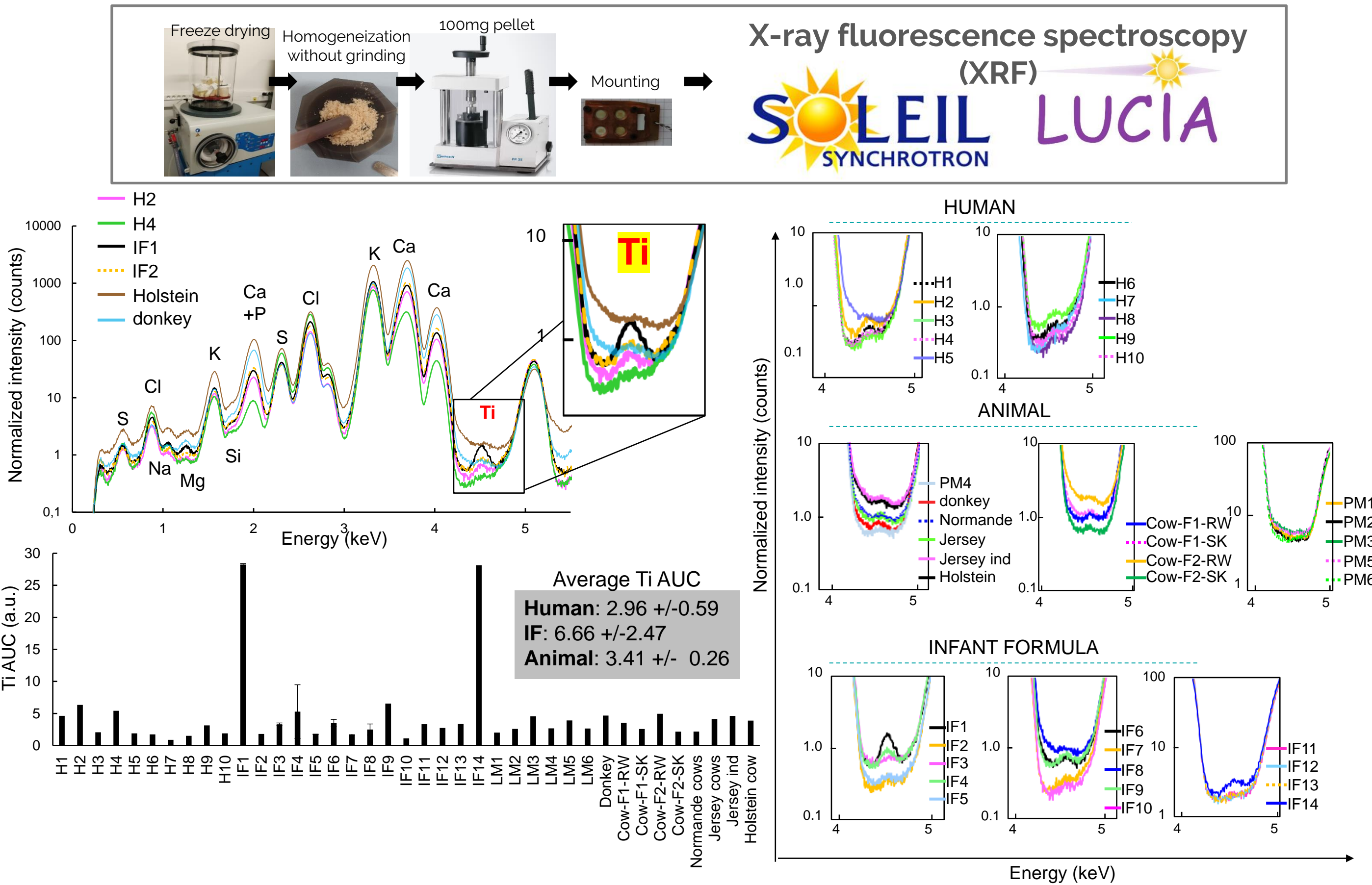
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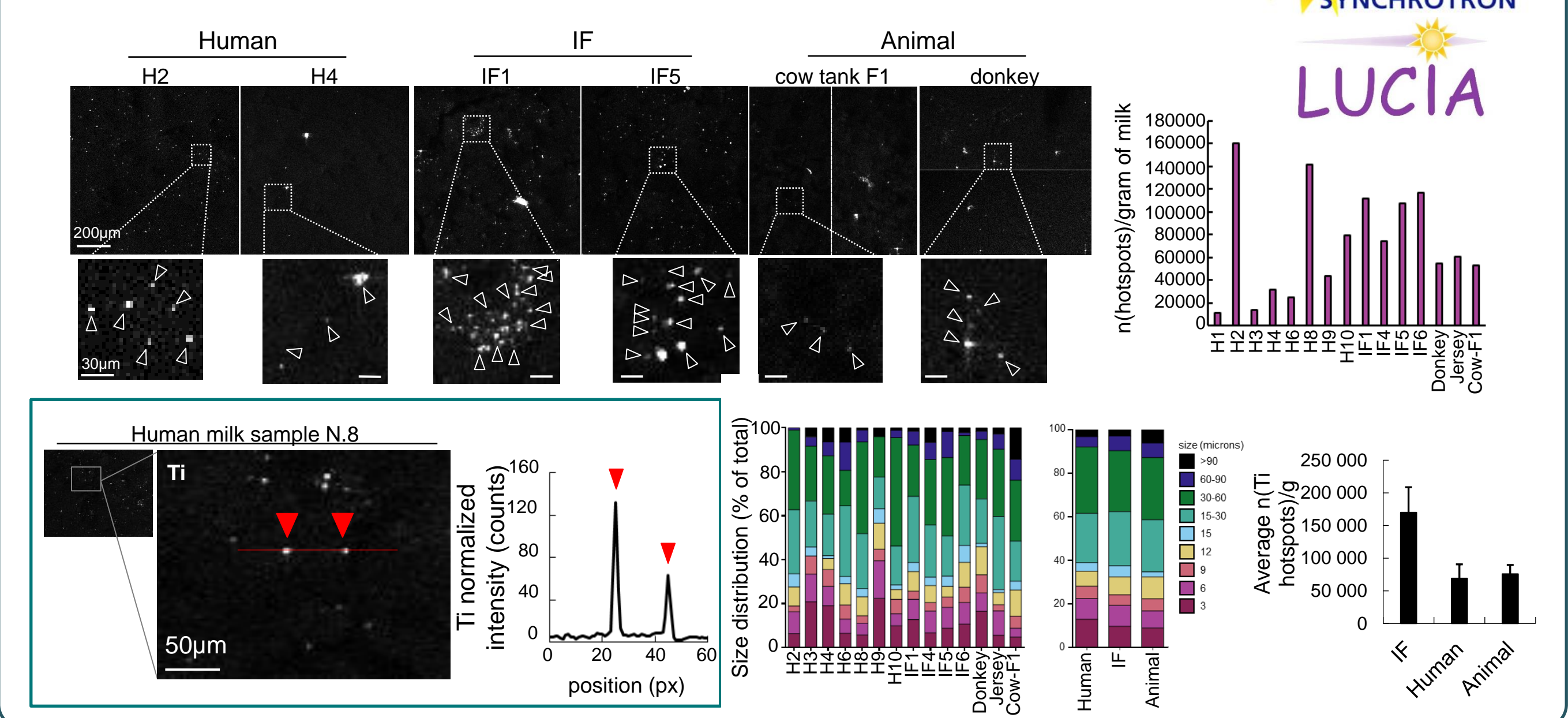
1 Titanium element is detected in mineralized milk samples



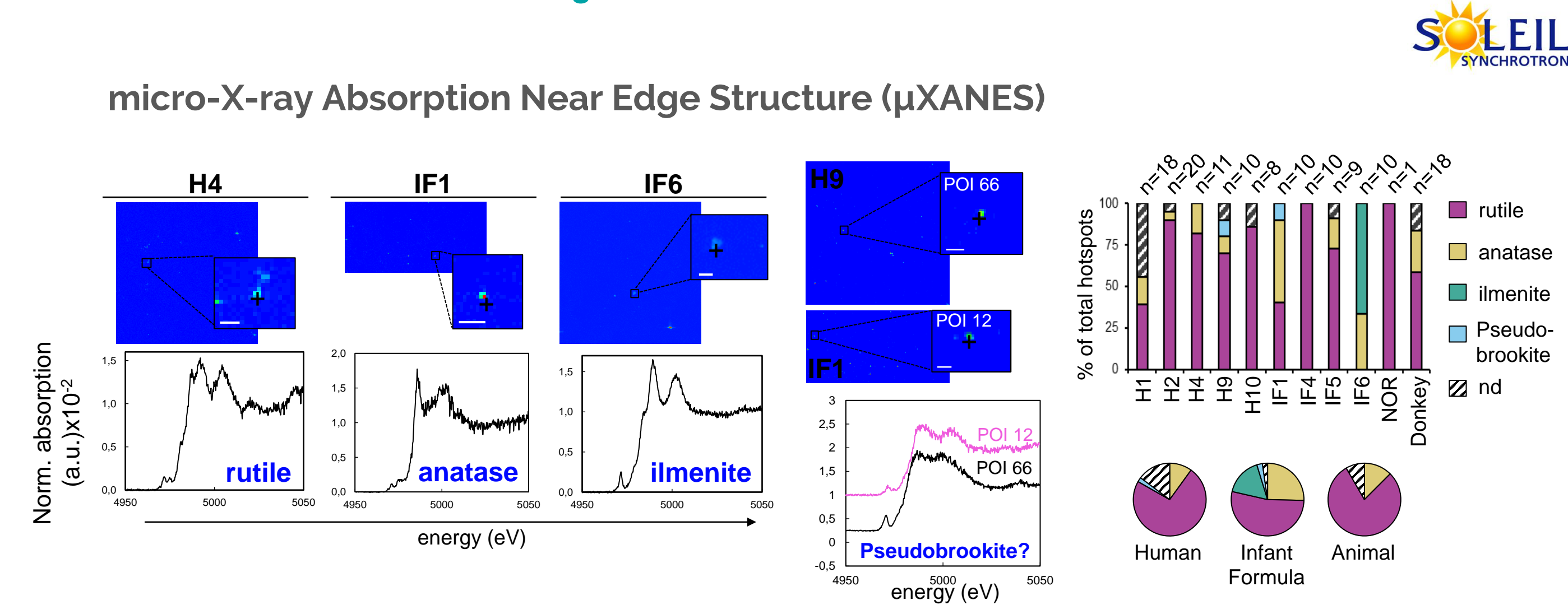
2 Element mapping of non mineralized milk samples revealed the presence of titanium element in all samples analyzed



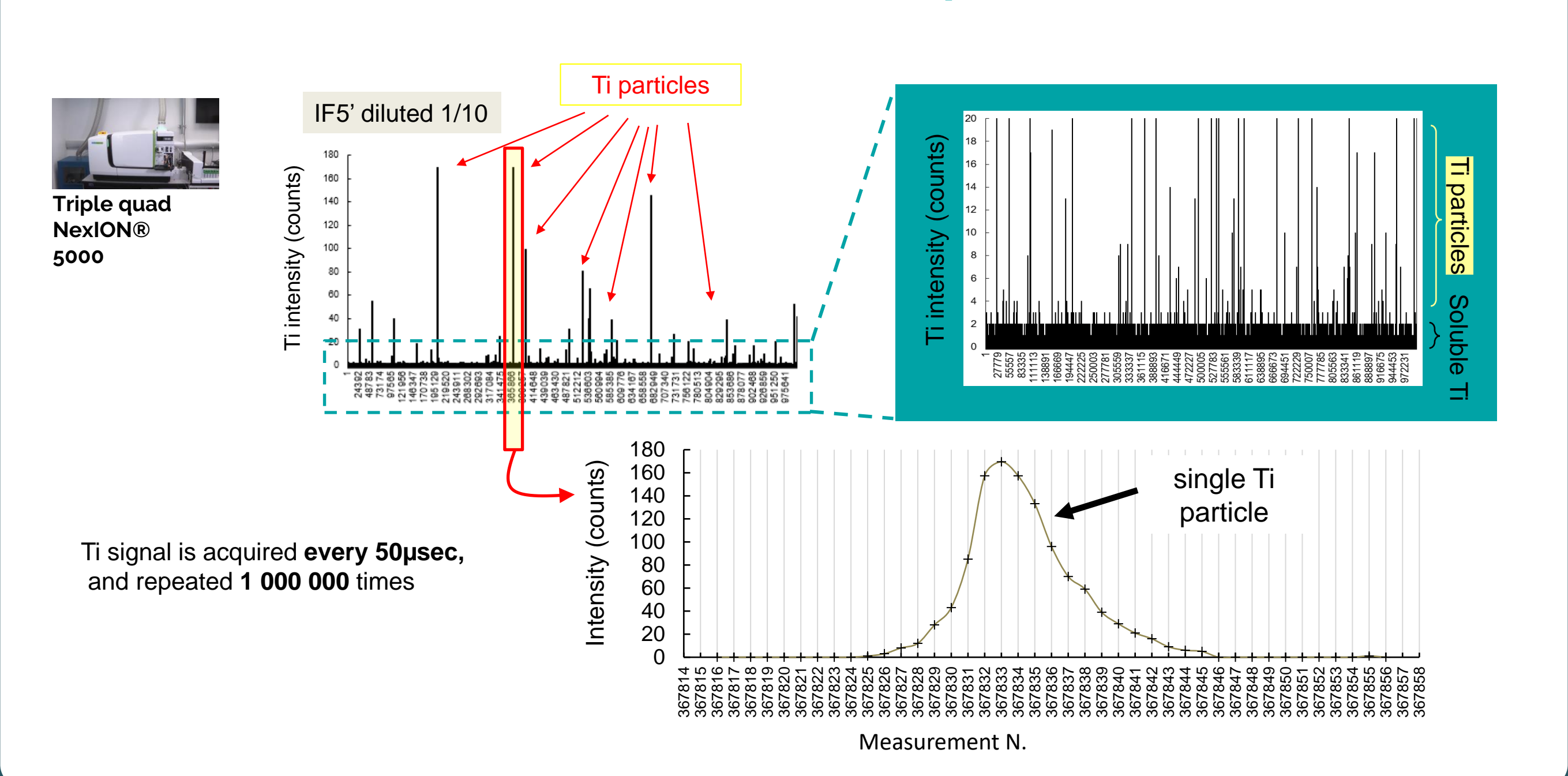
3 Titanium distributes in hotspots



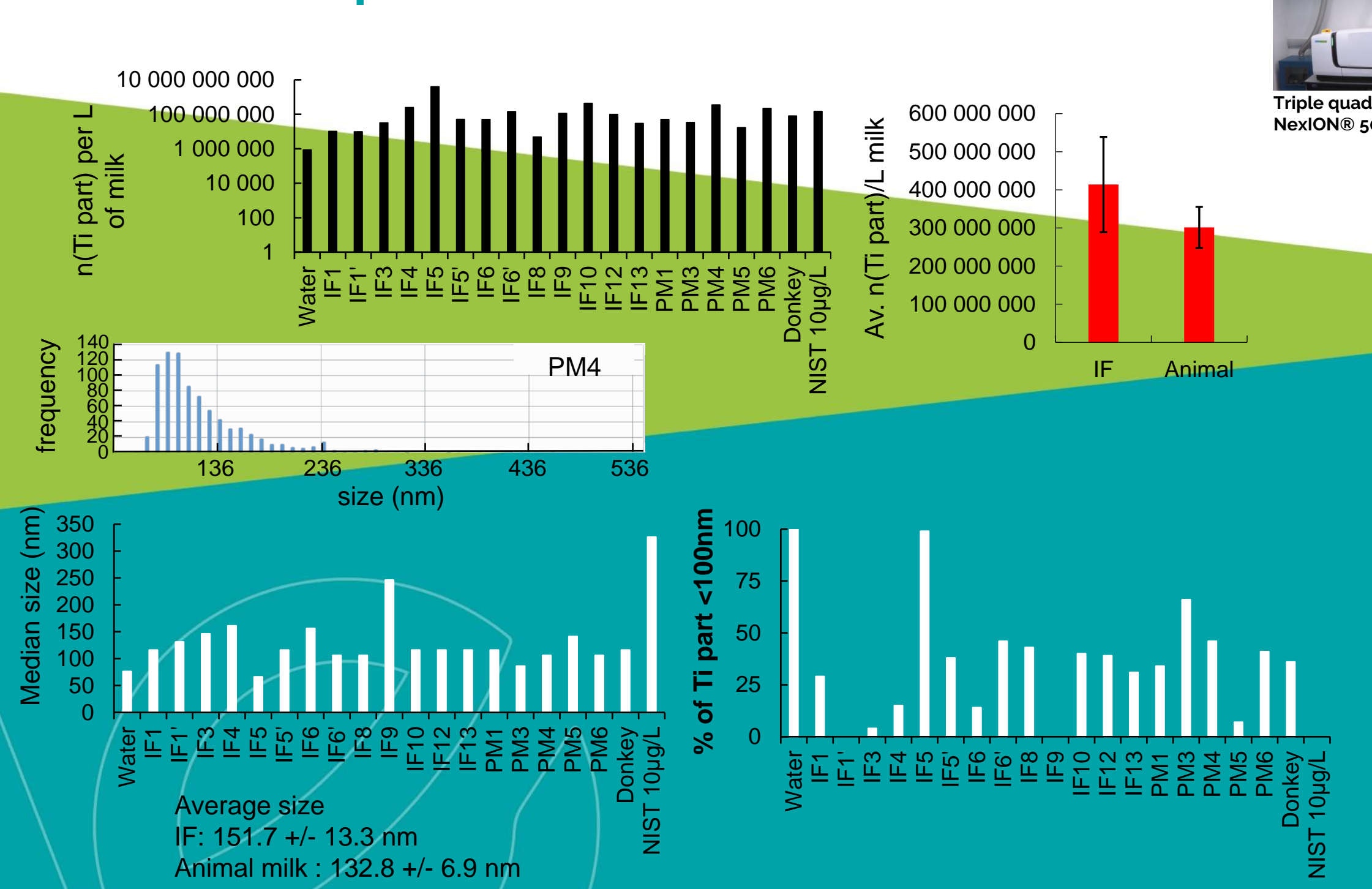
4 Milk contained various combinations of rutile TiO₂, anatase TiO₂, ilmenite Fe₂TiO₃ and titanite or pseudobrookite hotspots



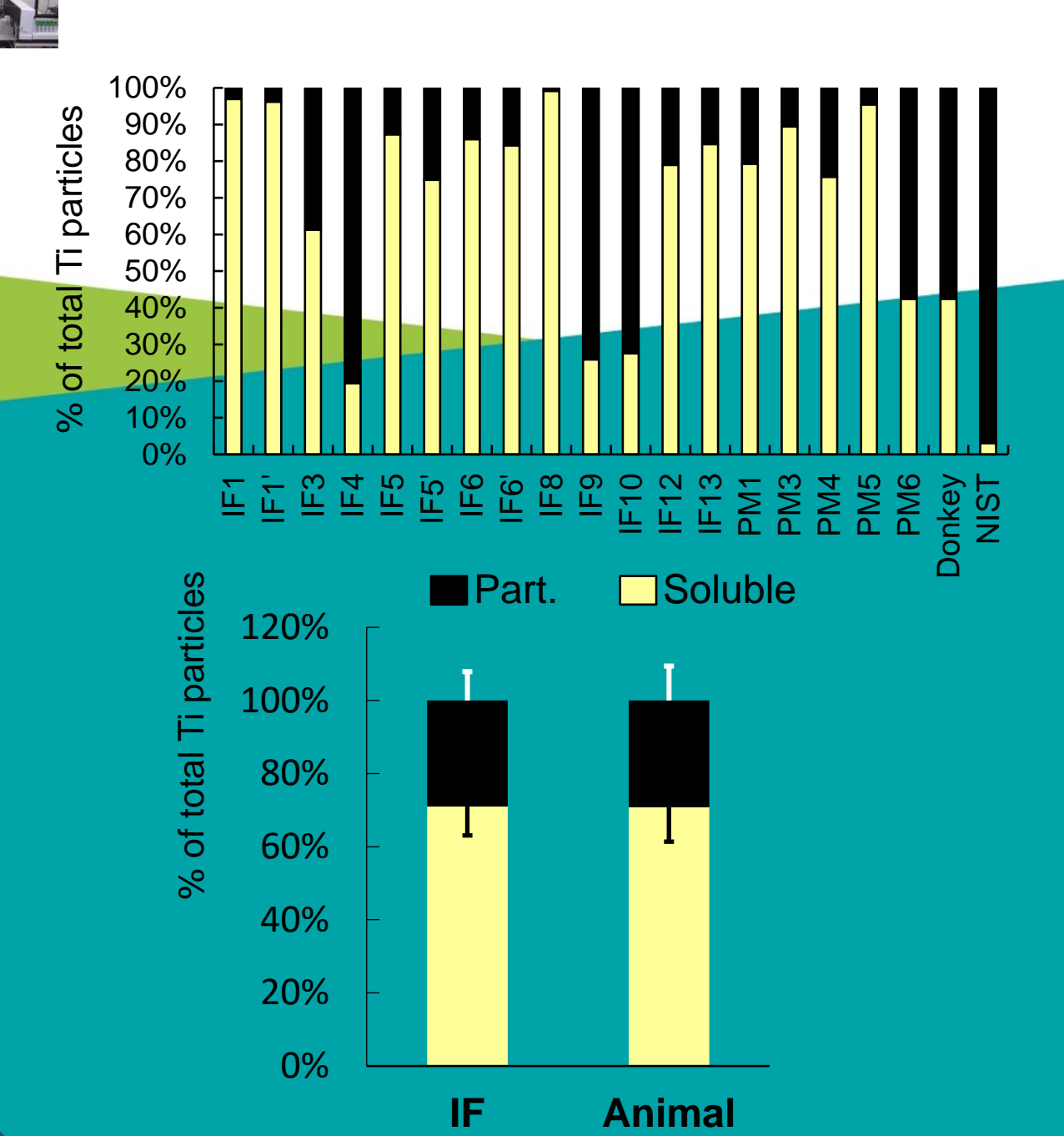
5 Single particle ICP-MS detects titanium particles and soluble titanium in native milk samples



6 Number, size, concentration of Ti particles and % of nanoparticles



7 Respective contribution of soluble vs. particles to total Ti



Take-home messages

- All samples contained titanium micro- and nano-particles, regardless of the species, location, and processing.
 - Concentration, sizes, and combinations varied
 - Rutile and anatase TiO₂, ilmenite Fe₂TiO₃ and possibly titanite CaTiSiO₅ or pseudobrookite Fe₂TiO₅.
- These findings suggest that milk carries titanium-containing nanoparticles and exposes chronically neonates to this nanomaterial until weaning.

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