

Phytolith reference collection of coastal plant communities at Farlington Marshes, Portsmouth, Hampshire *Dr Emma Karoune*

What are phytoliths?

Phytoliths are microscopic silica bodies formed within and between living plant cells from the uptake of soluble silica in ground water. They form in the shape of the cells and can therefore be used to identify plants to family, genus or sometimes even species level. They are highly produced in grasses and sedges but also occur in lower levels in most other plants.

What can we use phytoliths for?

Phytoliths can survive for thousands of years in sediments. This means that they can be used to identify plants from palaeoecological and archaeological deposits. Other plant remains are not as robust or are biased towards certain types of plant taxa. Therefore, adding phytoliths to the repertoire of methods applied to ancient studies will expand our knowledge of environmental changes and plant exploitation in the past.

Why do we need a British phytolith reference collection?

This method of examining plants from archaeological sites is used in many areas of the world but is rare in Britain. This work is hindered by the lack of identification criteria for the British flora and therefore it is aimed to create a comprehensive reference collection for all plant communities in the British Isles.

There are many archaeological and palaeoecological applications for phytolith analysis in Britain:

- To add more detail to the picture of past plant use for species that we can't identify using other plant remains.
- To investigate archaeological sites that have poor preservation of seeds and pollen.
- To examine long term changes in landscape and biodiversity.
- To investigate the introduction of agricultural communities into Britain, which is currently poorly understood.

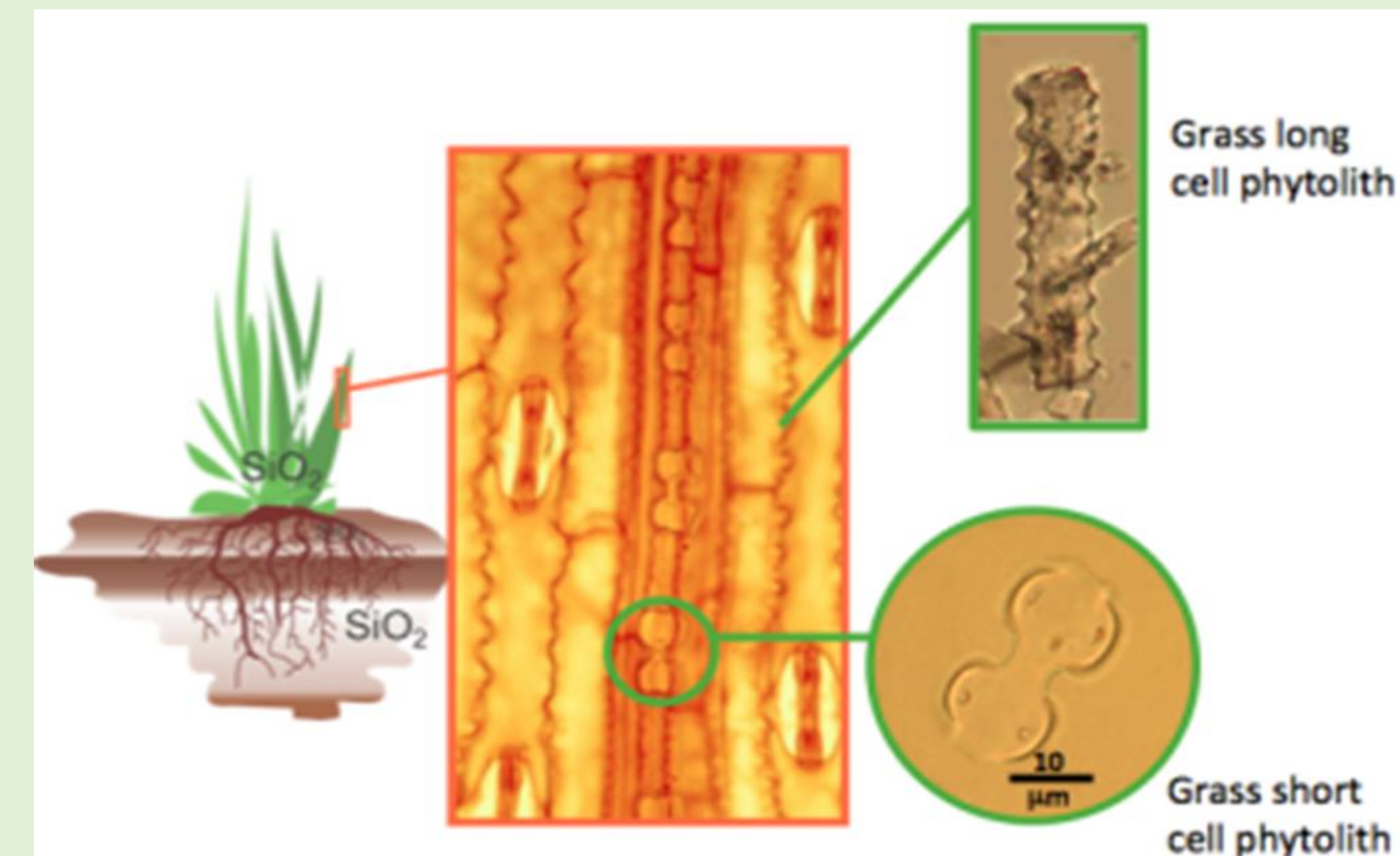
How were the plants sampled?

Taxonomic identification of phytoliths

Plant specimens were collected for identification purposes and to make a herbarium collection of the species found. These plants will be examined to work out ways to identify them to different taxonomic levels using phytoliths and also help to gain information about the quantity of phytoliths produced in these plant species.

Characterising plant communities

Quadrat sampling was done to compare the phytoliths found in the above-ground plants compared to the phytoliths found in the top soil below the plants. The percentages of phytoliths lost through wind and water transport can be determined and a phytolith signature can be determined to distinguished each plant community.



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Sea wall

- *Elymus athericus* - Sea couch
- *Dactylis glomerata* - Cock's foot
- *Atriplex portulacoides* - Sea Purslane (c)
- *Atriplex prostrata* - Spear-leaved orache
- *Beta maritima* - Sea beet
- *Inula crithmoides* - Golden samphire (a)
- *Crithmum maritimum* - Rock samphire (b)

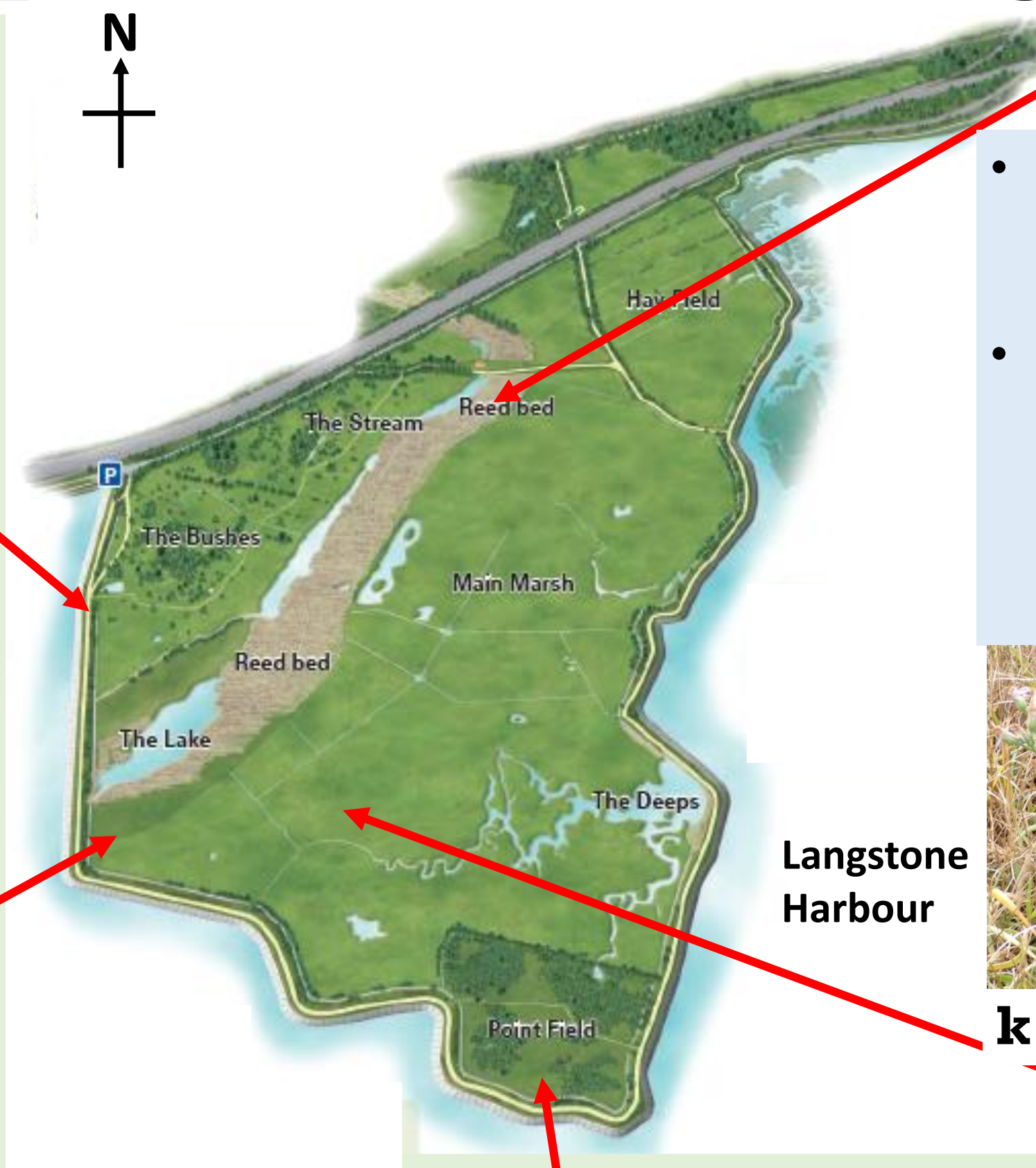


Lower salt marsh



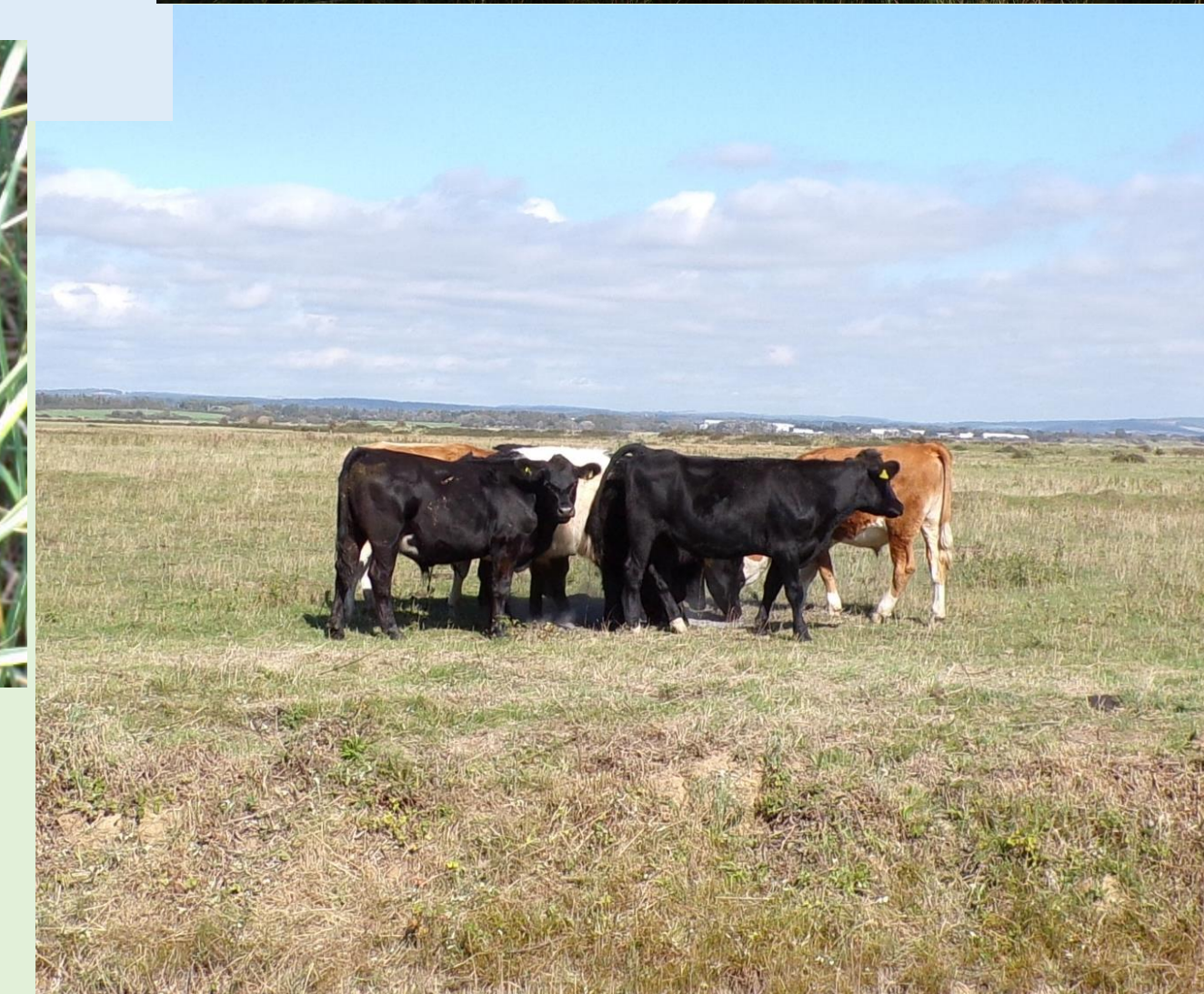
- *Spartina* sp. - Cord grass (f)
- *Suaeda maritima* - Annual Sea blite
- *Plantago maritima* - Sea Plantain (e)
- *Aster tripolium* - Sea Aster
- *Atriplex portulacoides* - Sea Purslane
- *Puccinella* sp. - Saltmarsh grass
- *Salicornia* sp. - Glasswort/Samphire (d)
- *Spergularia marina* - Lesser Sea-spurrey
- *Juncus gerardii* - Saltmarsh rush

What plants are at Farlington marshes?



Reed beds

- Dominated by *Phragmites australis*.
- But also mixed with other salt marsh species at the edges such as Sea aster (k), Sea club rush, and Grey Club-rush (l) (*Schoenoplectus tabernaemontani*).



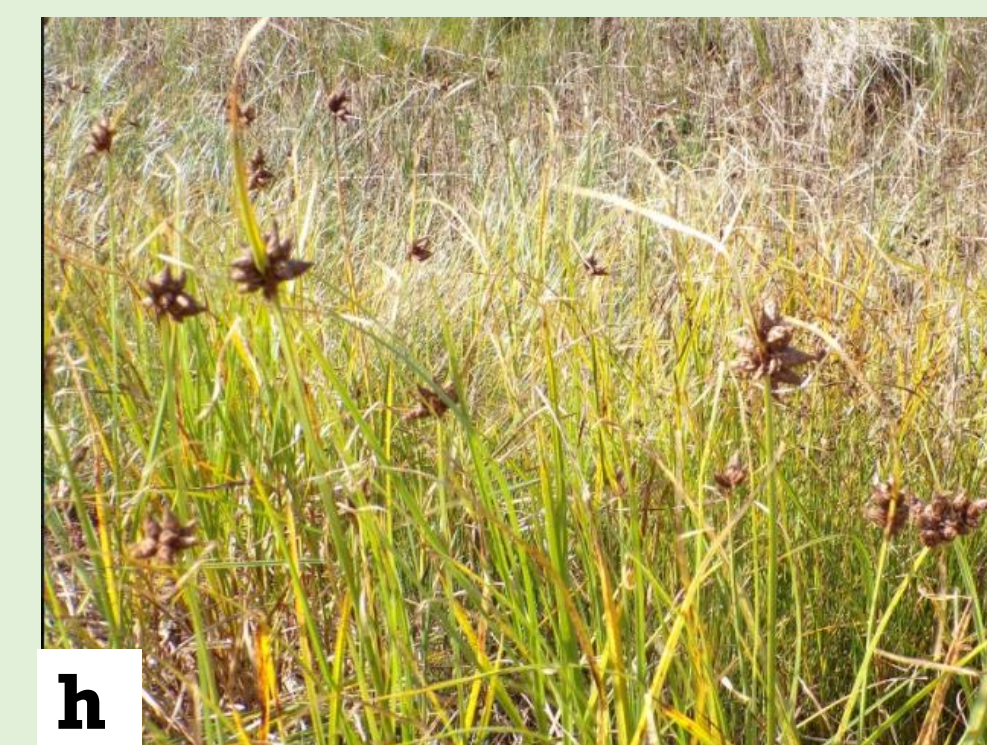
Grazing marsh

- *Agrostis stolonifera* - Creeping bent
- *Cynosurus cristatus* - Crested Dog's-tail
- *Trifolium pratense* - Red clover (i)
- *Lotus* sp. (j)
- *Plantago* sp. - Plantain
- *Oenanthe* sp. - Water-dropwort
- *Juncus inflexus* - Hard rush



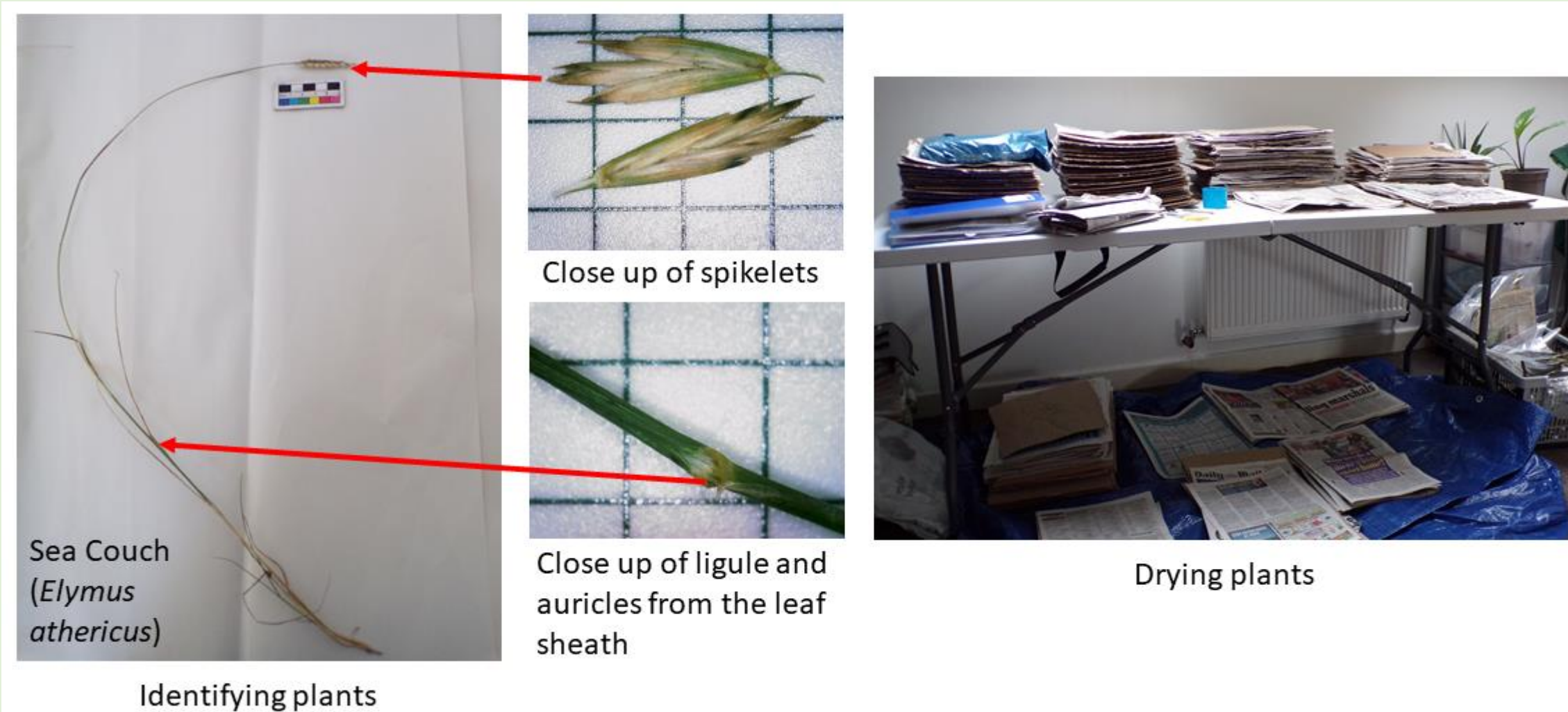
Upper salt marsh

- *Elymus athericus* - Sea couch (g)
- *Agrostis stolonifera* - Creeping bent (g)
- *Bolboschenus maritimus* - Sea Club rush (h)
- *Juncus gerardii* - Saltmarsh rush
- *Salicornia* sp. - Glasswort/Samphire
- *Rubus fruticosus* - Blackberry
- *Atriplex prostrata* - Spear-leaved orache
- *Cirsium arvense* - Creeping thistle
- *Rumex crispus* - Curled dock
- *Pulicaria dysentaria* - Common fleabane



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What I'm doing with the plants and soils?



The plants collected from Farlington Marshes are first identified and then dried to preserve them. It's important that all the plant identifications are checked by expert botanists and help with this is being kindly volunteered by Tony Mundell and Martin Rand - the BSBI Hampshire recorders.

How are phytoliths extracted?

Plant material

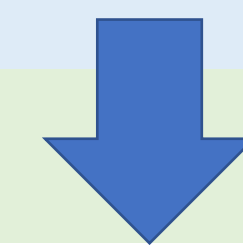
To extract the phytoliths from plant material, they are separated into plant parts (leaf, stem and inflorescence), weighed and put in a furnace at 500°C for at least two hours or until they are completely ashed. Once cool, they are washed with 10% HCl, then washed with distilled water and dried. They are then weighed again and mounted on to microscope slides to permanently preserve them. They can then be viewed under a transmitted light microscope.

Weighing the plants and the phytoliths extracted from them is a key part of my methodology to assess the production of phytoliths in these species. These data will be used to make adjustments during data analysis to take into account the differences in phytolith production by different plant taxa. This will hopefully create better reconstructions of past environments.

Soils

To extract phytoliths from soils, it is a lengthy process. All other components in the soil need to be separated from the silica. This includes getting rid of carbonates using acid, burning in a furnace to get rid of organic material, using gravity to separate clays and finally separating the silica phytoliths using a heavy liquid and a centrifuge. The silica left is mounted onto slides permanently preserving it.

All slides are examined for the different types of phytoliths that are present. The number of each type are counted and this can be related to the proportion of each plant present using data analysis.



What will the phytoliths look like?

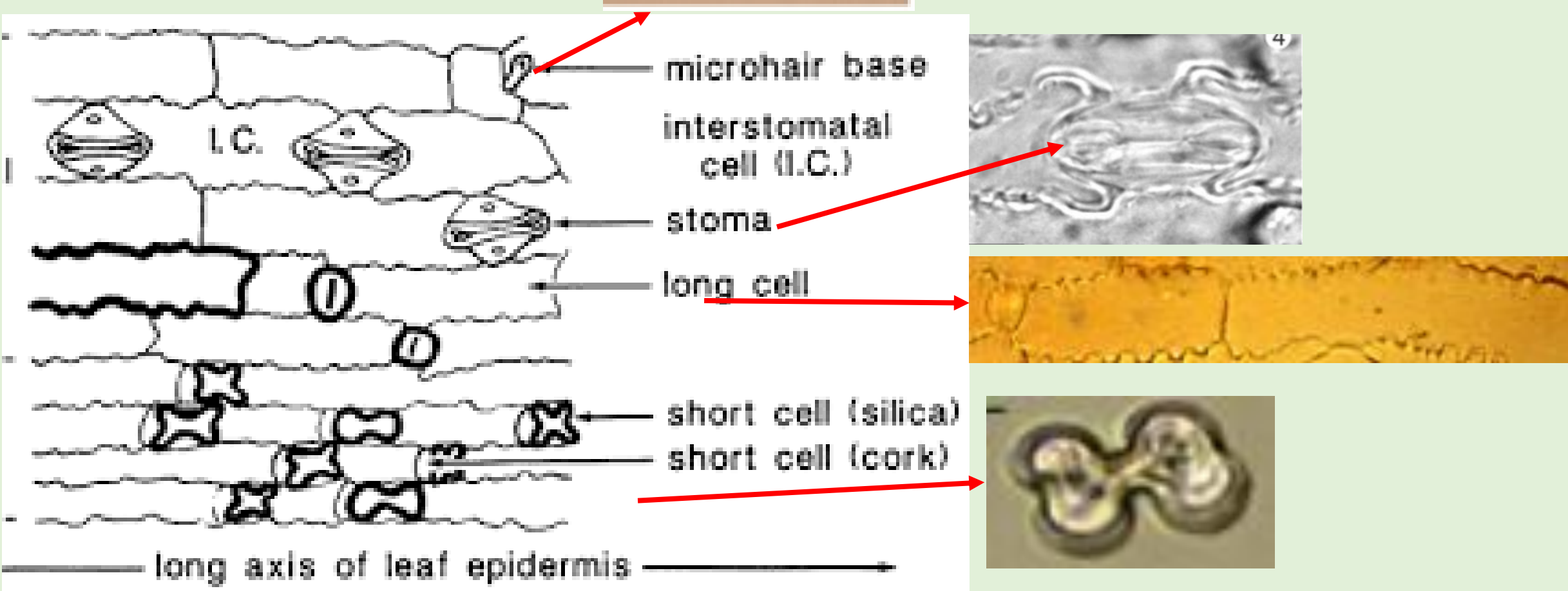
Work on individual plant species:

I don't know exactly what the phytoliths will look like as many of these species have not been examined for phytoliths before and no extensive work has been conducted to identify phytoliths from the British flora. But there has been work in other world regions therefore we know about the phytoliths found in certain plant families especially grasses:

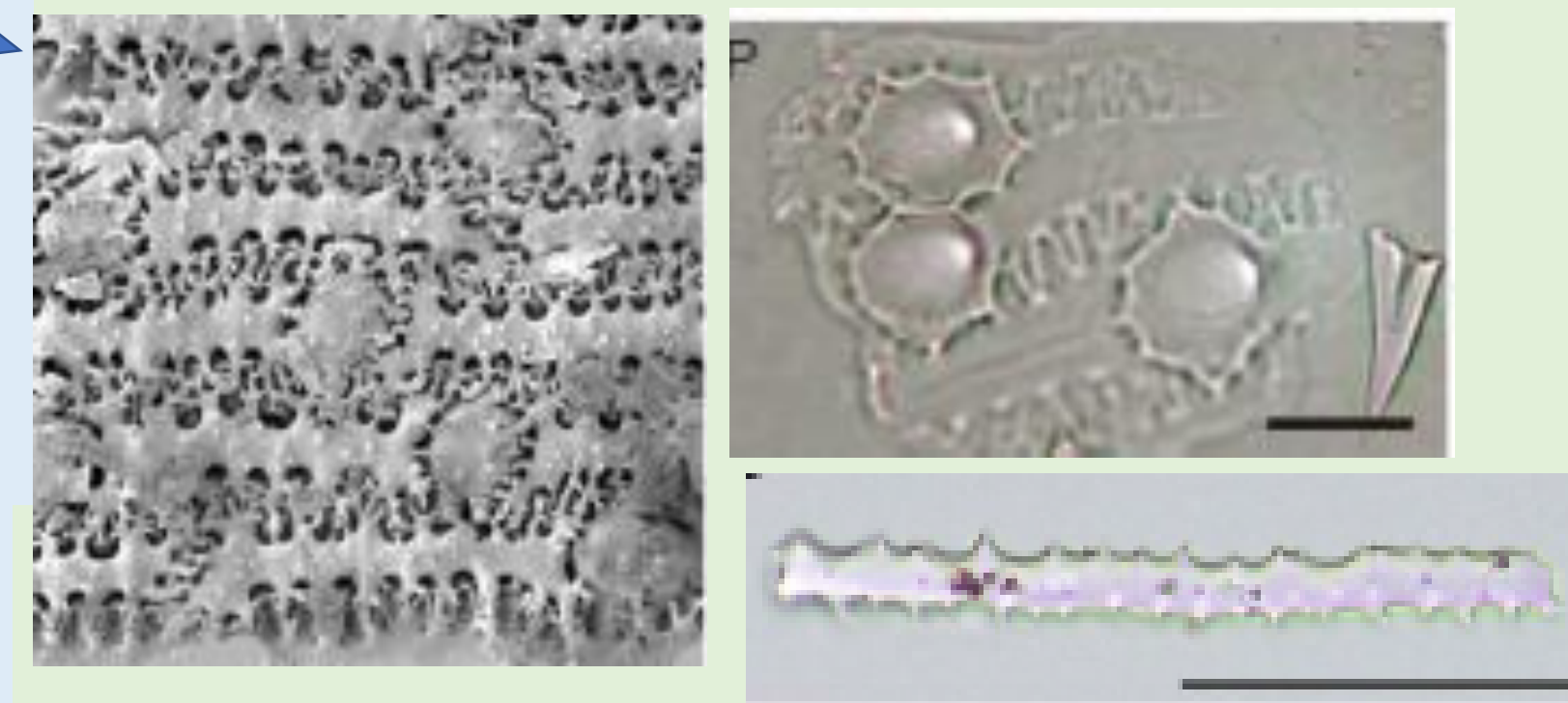
Leaves of grasses



Phytoliths are grouped into short and long cells (individual cells) and multi-cells (panels of joined cells).



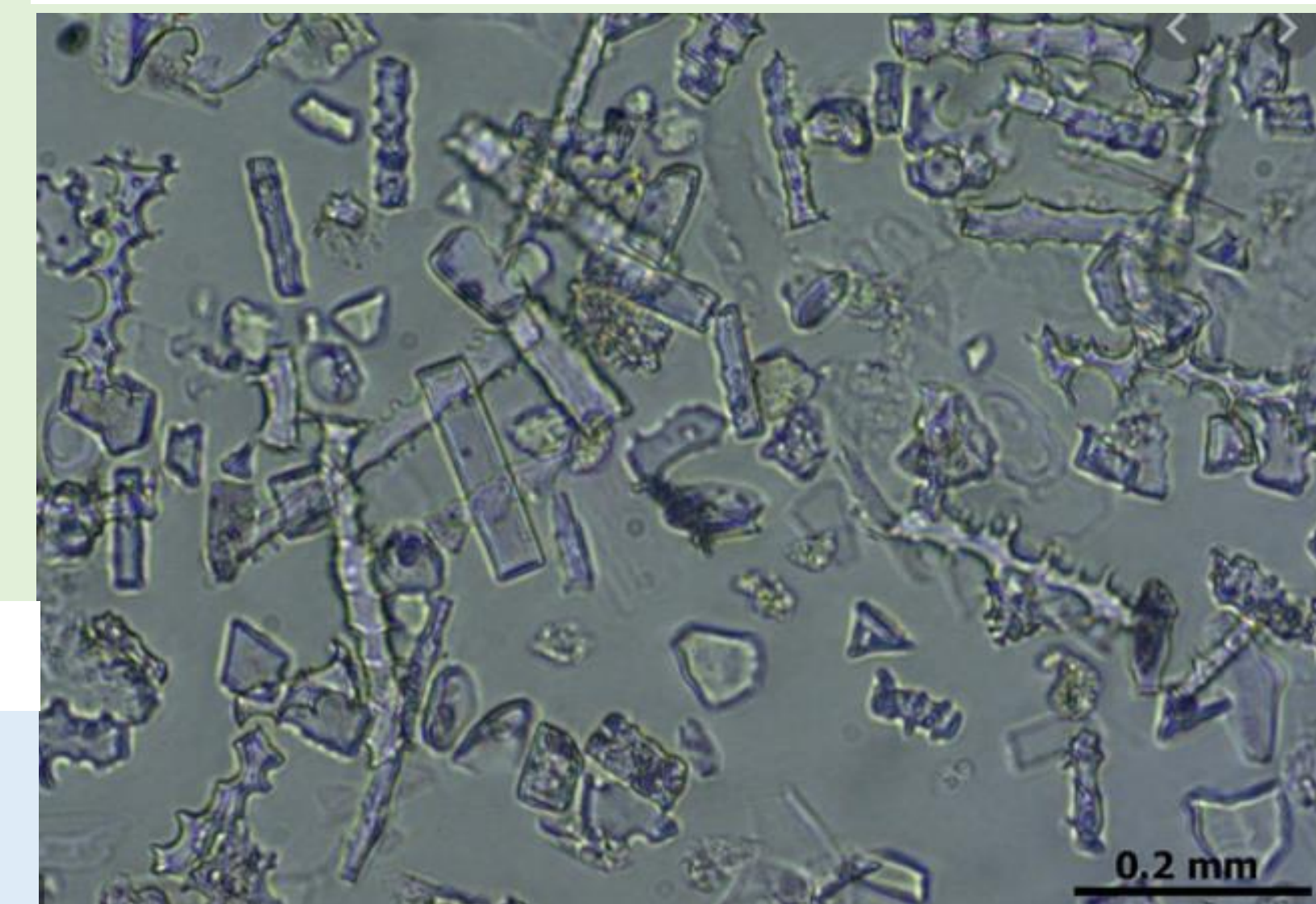
Inflorescences of grasses



What can be done with the identifications

- Identifying phytoliths to genus or species level is difficult but can be done if they have unique shapes or by measuring them (morphometrics) – this can point to particular indicator species for environments or human use of economic plants.
- Assemblage based approach** – certain types of phytoliths are indicative of certain plant groups such as sub-families of grasses. These can indicate general environmental changes – wet versus dry, grassland versus forest.

Mixed phytolith assemblages from soil samples



I count 200 to 300 short cells per slide and then about 100 multi-celled phytoliths.