Marine bio-glue: from molecular characterization to applications in wet environments

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Background

- Sources of inspiration to produce natural or synthetic bio-adhesives are diverse. Biological compounds are able to interact with different types of biotic and abiotic surfaces.
- Glues and adhesives inspired by nature are a great source for biomimetic developments, and have multiple interests regarding their area of use in industrial processes.

Bioadhesives are produced by a wide diversity of organisms. Some are used in multiple industrial processes.

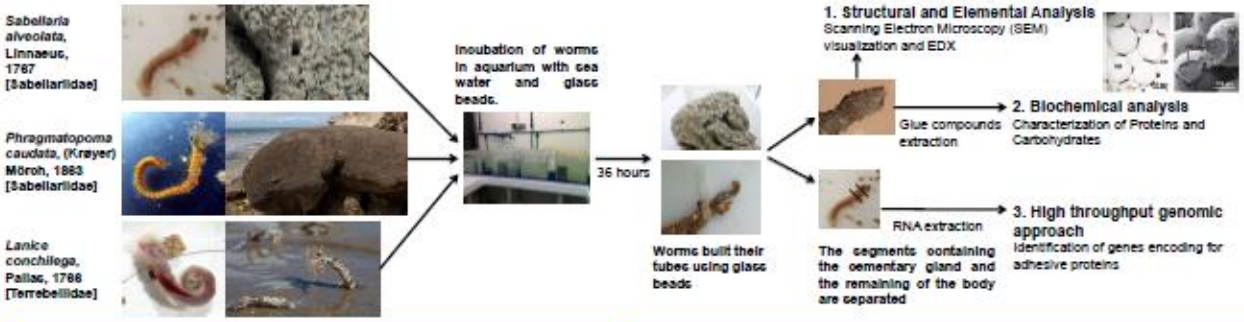
Among the various marine and fresh water organisms, some marine worm species of the Polychaeta phylum are capable of building tubes serving as protective houses by assembling and gluing sand grains and clasts in high energy environments. In addition, some isolated species are able to produce flexible or rigid tubes, but some gregarious ones, are able to create vast reefs.

Tube-building by marine Polychaetes worms in the bay of Mont Saint-Michel, France. (A) Reef-building by *Sabellaria alveolata*, (B) typical bed of *Lanice conchilega*.

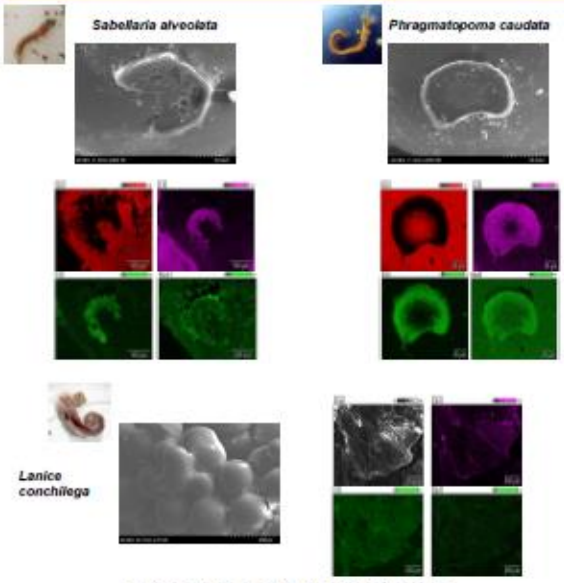
Objectives

At first, our project focuses on general approaches to identify and characterize organic compounds and molecular patterns used by Polychaetes species for adhesion. Secondly, in collaboration with our industrial partner, the R&D team "Produits, Systèmes et Solutions" of Saint-Gobain Isover, biomimetic approaches will be employed to adapt and transfer the molecules and functions to industrial processes.

Strategy to explore adhesion in Marine Polychaetes Worms



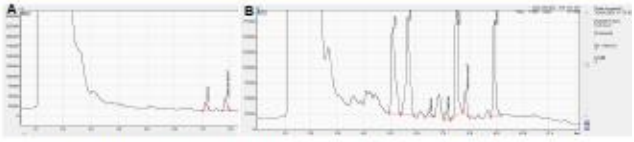
1. 3D structure and elemental composition of the glue



Visualization of cement by SEM and EDX analysis

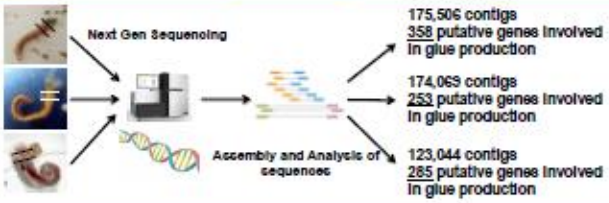
- Assembled beads by *S. alveolata* or *P. caudata* revealing cement spots. Cement discs are round-shaped with pores of different sizes, and contain mainly phosphate compounds.
- *L. conchilega* glued the beads with a visco-elastic adhesive chiefly made of phosphate (P) compounds.

2. Identification of Carbohydrates



Identification by gas chromatography of carbohydrates in cements (A) *S. alveolata* and (B) *L. conchilega*.

3. Identification of genes encoding for adhesive proteins



Perspectives

- **The contigs/genes identified with the high throughput genomic approach are currently being annotated using reference databases. The ~900 new proteins, that are putatively involved in glue formation, will be investigated for the presence of novel specific domains.**
- **Characterization of proteins forming the cement will be performed by mass spectrometry.**
- **With the R&D team of Saint-Gobain Isover, in the light of new knowledge of the glue produced by marine worms, we are discussing how we can improve adhesives for wet environment.**