**Cysteine production**

- E. coli was used to produce cysteine through the enzymatic activity of CysDes.
- The concentration of H₂S produced was determined using a ninhydrin test.
- CysDes was expressed in MOPS medium to test its enzymatic activity.
- The presence of cysteine was confirmed using the ninhydrin test.
- CysDes was overproduced and its degradation produced H₂S.

**Black crust elimination**

- Our bacteria are able to reduce the black crust by reducing sulfate and accumulating cysteine into pyruvate, ammonia, and hydrogen sulfide.
- The black crust is removed by our engineered bacteria, which overproduce cysteine and reduce sulfate.
- This process is effective on a variety of dirty stones, including those found in parks, alleys, and cemeteries.

**References**

[1] We engineered two new BioBrick devices directed to overproduce cysteine.

[2] Our results showed that our bacteria have a double effect: they decrease the expression of the downstream gene, and they also enhance the upstream's one.

**Outreach**

- AD, AT, FG, DR: Presentation
- AD, AT, JF, FG, GG, DR: Lab work
- Damiano Avi: Gas Chromatography

**Partners**

-НИТ Trento 2012

**Projects**

- Black crust
- Cysteine production
- Black crust elimination

**Figures**

- Fig.1: Time course for the expression of CysDes in vitro.
- Fig.2: Engineered E. coli to reduce aerobically sulfate.
- Fig.3: Cysteine levels produced in vitro by CysDes.
- Fig.4: H₂S production by CysDes.
- Fig.5: OUR BACTERIA ARE ABLE TO REDUCE THE BLACK CRUST.
- Fig.6: The black crust was formed and developed on sulfates.
- Fig.7: THE BLACK CRUST?
- Fig.8: The Crustonator: a homemade acid rain simulator.
- Fig.9: OUR BACTERIA ARE ABLE TO REDUCE THE BLACK CRUST.
- Fig.10: The black crust was formed and developed on sulfates.
- Fig.11: The black crust was formed and developed on sulfates.
- Fig.12: The black crust was formed and developed on sulfates.

**Tables**

- Table 1: Characteristics of terminators.
- Table 2: Comparison of terminators.

**Graphs**

- Graph 1: Time course for the expression of CysDes in vitro.
- Graph 2: Engineered E. coli to reduce aerobically sulfate.
- Graph 3: Cysteine levels produced in vitro by CysDes.