Rapid evolution of key phytoplankton species to a high pCO_2 ocean (BIOACID subproject 1.1.4)

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The increase in ocean pCO_2 levels and the related change in seawater carbonate chemistry have been found to cause versatile effects in contemporary marine primary producers.
Considering the fast generation time of most phytoplankton groups, evolutionary changes as a response to the ongoing increase in pCO_2 are expected. These changes are likely to be rapid and substantially influence the physiological response of evolved phytoplankton populations to increased pCO_2.
From a biogeochemical perspective coccolithophores are of high interest as key primary producers in the oceans, featuring photosynthesis and calcification. From an evolutionary perspective their high standing genetic variation in natural populations may hold the potential to cope with rapidly changing environments. Moreover, short generation times suggest a high potential for rapid adaptation by new mutations.
Starting from novel isolates obtained from natural phytoplankton assemblages we have established replicated multi-clonal selection lines with large population size under present day and increased pCO_2 levels. Cultures will be run for about 500 generations of exponential growth. Reciprocal pCO_2 experiments will be performed every 100 generations to test for adaptation.
By this means we intend to identify the genetic basis of physiological changes in response to elevated pCO_2 levels, using state-of-the-art genomic and transcriptomic techniques. Relative fitness of multi-clonal selection lines and reciprocal populations is assessed. Further response variables are monitored, including photosynthetic rates, chemical stoichiometry and calcification rates.