Concerns over global climate change have generated interest in imitating biological carbon-fixing systems for converting atmospheric carbon dioxide. Ammonia-oxidizing Thaumarchaeota fixes the inorganic carbon into organic carbon using a modified carbon fixation pathway called 3-hydroxypropionate/4-hydroxybutyrate (3-HP/4-HB) cycle. Thaumarchaeon *Nitrosopumilus maritimus* (*N. maritimus*) was discovered to use the most energy-efficient carbon fixation mechanism under nutrient-limited conditions. Understanding the carbon fixation and carboxylation mechanisms are of great importance as certain precursors produced in these pathways can be used for industrial purposes. The key step of the cycle, carboxylation of acetyl-CoA and propionyl-CoA is catalyzed by a biotin-dependent single bifunctional enzyme called Acetyl-CoA/Propionyl-CoA carboxylase [1, 2]. In this study, we have determined the first structure of the carboxyl transferase subunit Nmar_0272 at 2.23 Å resolution and reconstructed certain disordered regions by using AlphaFold. Our work will shed light on the carbon-fixation mechanism and help us better understand how some of the archaeal species can thrive under oligotrophic conditions.

**Figure 1.** A) The Thaumarchaeon 3-hydroxypropionate/4-hydroxybutyrate (3-HP/4-HB) cycle. B) Carboxyltransferase subunit of Acetyl-CoA carboxylase.

