## Divalent cation-induced conformational changes in archaeal surface structures: A study of a deepsea hyperthermophilic methanogen using FTIR spectroscopy

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Prokaryotes are profoundly successful in part due to the functional adaptability and form of their surface structures. However, there are outstanding fundamental questions related to the biochemical basis and mechanistic purpose of cell surfaces. This is especially true with respect to archaeal cells and the near universal presence of S-layer proteins coating their surfaces. This work aimed to explore the variability on the surface of a deep-sea hyperthermophilic methanogen (Methanocaldococcus sp. FS406-22) passively induced by changes in the chemical makeup of the surrounding environment. Experimentally, dormant cells were suspended in four different background electrolyte solutions that varied in their concentrations of sodium, calcium, and magnesium. We analyzed the surfaces using ATR-FTIR spectroscopy as a function of pH in each background electrolyte. The resulting spectra revealed notable shifts in the peaks related to ether links within polysaccharides when in presence of magnesium at high pH (>8). Archaea possess a high density of sugars anchored to the outer edge of S-layer proteins (glycoproteins), a property rarely seen in bacterial cells. The results suggest that the observed spectral shift is due to magnesium-induced conformational changes to surface glycoproteins. This work provides evidence that the biochemical and structural composition of the surface of this organism can undergo passive adaptation to changes in the surrounding environment. Not only could this provide important structural stability/diffusion regulation for the cell but also has the potential to significantly impact the overall surface reactivity and micronutrient adsorption.