

## PIONEERING UNDERSTANDING OF COLD ADAPTATION IN ARCHAEA (THE THIRD DOMAIN OF LIFE): UNIQUE MICROORGANISMS FROM LAKES IN THE VESTFOLD HILLS

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Archaea are ubiquitous microorganisms that have been detected in most extreme and non-extreme, terrestrial and aquatic environments. Psychrophilic archaea perform diverse functional roles in a wide range of cold environments and their environmental impact is well illustrated by their abundance in the ocean, estimated at  $\sim 10^{28}$  cells. Despite their relevance to fields as diverse as biotechnology and astrobiology, cold adapted archaea have been surprisingly understudied. One obstacle has been their recalcitrance to isolation.

*Methanococcoides burtonii* and *Methanogenium frigidum* were isolated from Ace Lake in the Vestfold Hills through the pioneering efforts of Peter Franzmann and colleagues. Laboratory based studies on these isolates is leading the international field's understanding of cold adaptation in archaea. Advances in understanding the biology of cold-adapted archaea have occurred primarily through studies of protein structure, intracellular solutes, membrane lipids, tRNA modification, gene regulation, proteomics and comparative genomics. The greatest single advance in understanding these organisms has come through genome sequencing efforts (*M. burtonii* and *M. frigidum*); programs of research which have involved funding agencies and sequencing facilities from Australia and the USA. These efforts are ongoing and include the genome sequencing of the haloarchaeon, *Halorubrum lacusprofundi*. In view of the depth of knowledge of Ace Lake and the surrounding Vestfold Hills, and the level of understanding of archaeal cold adaptation that has been generated from studies on *M. burtonii* (and *M. frigidum*), it is clear that this system represents a powerful model for studying the evolution of psychrophiles. Progress in the future will accrue most rapidly from broad integrated studies that involve metagenomics and associated functional studies of Ace Lake, and others such as Deep Lake.

This presentation will document the diverse and critical roles that *Archaea* play in cold environments, and highlight the rapid advances in cold adaptation biology that can be achieved through integrated genomic and functional genomic studies of model isolates.