Nature Reviews Microbiology | AOP, published online 9 May 2011; doi:10.1038/nrmicro2579

BACTERIAL PHYSIOLOGY

Motor helps gliders to gain traction

> the AglRQS motor sits in the cytoplasmic membrane, coupled to both the MreB cytoskeleton and to the substratum, and uses the PMF to power gliding motility.

Myxococcus xanthus cells move across a surface by one of two mechanisms: twitching motility and gliding motility. Whereas the pilus-driven mechanism of twitching motility is relatively well characterized, far less is known about the manner in which force is generated to propel the cell across the substrate surface during gliding motility. Now Sun *et al.* show that gliding is driven by membrane-bound motor complexes that are transported along the axis of the cell.

The authors had previously shown that a yellow fluorescent protein (YFP)-tagged version of adventurous-gliding motility protein Z (AglZ), a gliding regulatory factor, formed spatially periodic foci that remained in a fixed position relative to the substrate over which the cell was gliding. To further investigate the potential role of these foci during gliding, the authors immobilized *M. xanthus* cells expressing AglZ–YFP and observed processive and unidirectional transport of fluorescent foci from one end of the cell to the other. When the authors bound polystyrene beads to the surface of the immobilized cells, AglZ–YFP levels increased in the vicinity of the beads, and the beads were transported along the cell surface. Treating the immobilized cells with the drugs A22 (which depolymerizes rod shape-determining MreB filaments) or nigericin (which reduces the proton gradient across the cytoplasmic membrane) disrupted the AglZ–YFP foci and blocked bead movement, suggesting that AglZ foci have a role in connecting the cell surface with the intracellular cytoskeleton and driving gliding motility in a manner that depends on the proton-motive force (PMF).

To identify those components of the AglZ foci that might be involved in generating PMF-dependent movement, Sun *et al.* searched the *M. xanthus* genome for putative proton-channel-type motors based on homology to known motors such as the MotAB motility proteins, which drive flagellar rotation. They identified the three-gene *aglRQS* locus as encoding putative orthologues of MotA (AglR) and MotB (AglQ and AglS) and found that deletion of each of these genes eliminated gliding but not twitching motility. Co-immunoprecipitation experiments and fluorescent labelling revealed that AglR, AglQ and AglS form a complex that colocalizes to the same foci as AglZ. Importantly, in immobilized cells from an *aglQ* deletion strain, the AglZ–YFP foci remained located in fixed positions in the cells.

The authors propose a model in which the AglRQS motor sits in the cytoplasmic membrane, coupled to both the MreB cytoskeleton and to the substratum, and uses the PMF to power gliding motility. However, the factors that are important for making these connections and the mechanics of force generation during gliding remain to be determined.

Andrew Jermy

ORIGINAL RESEARCH PAPER Sun, M. *et al.* Motor-driven intracellular transport powers bacterial gliding motility. *Proc. Natl Acad. Sci. USA* **108**, 7559–7564 (2011)
FURTHER READING Zusman, D. R. *et al.* Chemosensory pathways, motility and development in *Myxococcus xanthus*. *Nature Rev. Microbiol.* **5**, 862–872 (2007) | Nan, B. *et al.* Myxobacteria gliding motility requires cytoskeleton rotation powered by proton motive force. *Proc. Natl Acad. Sci USA* **108**, 2498–2503 (2011)