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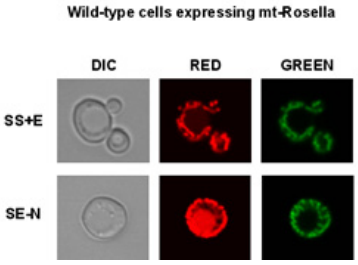
Fluorescent protein technology has revolutionised the way in which we carry out experiments in the life sciences, and few areas of biological research remain untouched by the technology. Fluorescent proteins such as the green fluorescent protein (GFP) cloned from the jellyfish Aequorea victoria, have been engineered to produce proteins with different fluorescent properties (for example see picture) useful for sensing a vast range of events in living cells. GFP is just one member of the protein superfamily found in marine organisms. Although each member folds to form the same 11-stranded b-barrel a variety of different chromophores (the light emitting component buried inside the barrel) together with the complex network of interactions between the chromophore and the surrounding amino acid side-chains (the protein matrix) determine the myriad range of optical properties.

Our aim is twofold: (a) understand the complex and subtle relationship between FP structure and optical properties, and (b) use newly acquired knowledge to design and engineer new FPs for novel biotechnology applications. In particular we are exploring their use in the fields of autophagy research, super-resolution microscopy and optogenetics. In the new and exciting field of optogenetics light-sensitive probes are used together with focussed light to switch processes 'on' and 'off' in living cells, tissues and intact organisms.

Research Projects

1. **Engineering and characterization of FPs with useful optical properties**
2. **Developing probes for optogenetics**
3. **Developing probes and using FP for super-resolution microscopy**
4. **Autophagy of mitochondria (mitophagy)**
5. **Autophagy of the nucleus (nucleophagy)**
6. **Developing new biosensors for accelerating autophagy research**



The Rosella biosensor targeted to mitochondria (mt-Rosella) is delivered to the vacuole under conditions of nitrogen starvation. The images shown are for wild-type cells undergrowing conditions (SS+E) and after a 6 hr period of nitrogen starvation (SS-N).

Selected significant publications:

1. Cullinane M, Gong L, Li X, Lazar-Adler N, Tra T, Wolvetang E, **Prescott M**, Boyce JD, **Devenish RJ**, Adler B. 2008. Stimulation of autophagy suppresses the intracellular survival of *Burkholderia pseudomallei* in mammalian cell lines. *Autophagy* 4, 744-753.
2. Rosado C, Mijaljica D, Hatzinisiriou I, **Prescott M**, **Devenish RJ**. 2008. Rosella – a fluorescent pH-biosensor for reporting vacuolar turnover of cytosol and organelles in yeast. *Autophagy* 4, 205-213.
3. Nowikovsky K, Reipert S, **Devenish RJ**, Schweyen RJ. 2007. Mdm38 protein depletion causes loss of mitochondrial K+/H+ exchange activity, osmotic swelling and mitophagy. *Cell Death and Differentiation* 14, 1647-1656.
4. Gavin P, **Prescott M**, Luff SE, **Devenish RJ**. 2004. Cross-linking ATP synthase complexes in vivo eliminates mitochondrial cristae. *Journal of Cell Science* 117, 2333-2343.
5. Petersen J, Wilmann PG, Beddoe T, Oakley AJ, **Devenish RJ**, **Prescott M**, Rossjohn J. 2003. The 2.0-A crystal structure of eqFP611, a far red fluorescent protein from the sea anemone Entacmaea quadricolor. *J Biol Chem* 278(45):44626-31