The formation of planets: Problems and prospects

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With the discovery of over 80 planets outside our own solar system our ideas of the formation of planetary systems have evolved. In particular, we now know that our own solar system is not representative of all planetary systems as it was often theorized. In addition, the presence of Jupiter–like planets at close distances to their stars has pointed towards the fact that large scale motions of planetary bodies may occur at least in some systems. Thus, the currently observed semi-major axis of a planet may not necessarily correspond to the location where the planet was born. With this in mind, it is important to re-examine all the hypothesis of the current planet formation paradigm in order to check where unwarranted assumptions have been made or important aspects omitted.

Collisional accretion is certainly believed to be the central process ensuring planetary growth even though various aspects of it remain poorly understood. From a dynamical point of view, considerable progress has been achieved in recent years in the simulations of the evolution of a swarm of self-gravitating bodies but a complete self-consistent description is still out of reach. In particular, we are still unable to obtain an accurate detailed history of all impacts suffered by a specific body over its lifetime.

The modelling of the collisions proper has also seen enormous progress with the development of sophisticated hydrocodes that allow ever more realistic simulations of the outcome of specific collisions. However, on the small scales, the sticking mechanism between planetesimals too small for gravitational forces to play a role (up to sizes of kilometres) is still largely unknown. On the intermediate scales asteroid families provide the necessary constraints to test our understanding of collisions in the gravitational regime. Finally, on the largest scales, giant impacts involving terrestrial but also giant planets may have dynamical and especially chemical consequences that one is only beginning to explore. New results pertaining to these points will be presented and discussed.

Geomicrobiology of carbonate precipitations at the surface of pyroxenes in an aridic soil

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The alteration of silicates by CO_2 followed by precipitation of carbonates is of great geochemical and geodynamical importance for the carbon cycle at the surface of the Earth, but also at depth. We have studied these reactions in the context of an aridic soil from Tataouine (Tunisia) in order to evaluate the importance of such non-classical but widespread environments. The samples investigated are a challenge for molecular ecology because of relatively low biomass and could be informative for analysis of similar reactions in deeply buried biosphere. At Tataouine, pyroxene crystals were delivered by a meteorite fall which occurred 71 years ago, thus providing a precise timing for the alteration reactions.

The microbial diversity of the sand was analysed by sequencing the DNA fragments (*rrs* gene) encoding the 16S ribosomal subunit. Among others, cyanobacterial groups and groups containing numerous radioresistant species were observed.

An important result of this study was to show that the microbial diversity of separated mineral fractions from the sand was different from the total diversity. Carbonates show a larger biodiversity than pyroxenes. *Rhizobium rrs* gene sequences were found in pyroxene fractions. A differential colonization of pyroxenes and carbonates has thus been evidenced; possible analytical biases will be discussed. Colonization experiments of those minerals were carried out with selected strains for better constraining rate and mechanism of the colonization processes

Morphological characteristics of species observed in enrichment cultures from sand samples were correlated to observed nano-bacteriomorph objects. Those species observed in enrichment cultures were also observed in the total diversity. Potential S-layers protein structures were identified in those strains. Their role for carbonate precipitation at a global scale as well as the methodological implications of this study will be discussed.