Magnetic records of early planetary differentiation

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Several classes of meteorites formed during the first stages of
planetary evolution may record the early history of
differentiation and possibly even magnetic field generation in
planetary cores. We have been conducting paleomagnetic
analyses on angrites, among the oldest known pristine basaltic
meteorites, and the CV carbonaceous chondrite Allende,
traditionally thought to sample an undifferentiated body. We
found that angrites record a past magnetic field of ~10
microtels on the angrite parent body extending from 4564 to
at least 4558 million years (Ma) ago. Allende, which acquired
its magnetization over millions of years at least 10 Ma after
accretion of the CV parent body, records fields of similar
intensity. Because the angrite and Allende paleomagnetic
records extend beyond the expected lifetime of the early
circumstellar disk, these paleofields were probably generated
internally on the parent bodies, possibly by early dynamo in
rapidly formed metallic cores. In particular, the CV parent
planetary may be a partially differentiated body with an
unmelted, relic chondritic surface that was magnetized during
metasomatism in the presence of an interior metallic core
dynamo. Planetary core dynamo may have been
widespread but short-lived phenomena in the early solar
system.

P/Ca in planktonic foraminifera
as a new proxy for marine PO₄:
Results from the Carriaco Basin

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Recent work has shown evidence for a new seawater
nutrient proxy in P/Ca ratios in corals [1, 2]. In foraminifera,
early research suggested that phosphorus only exists in Fe-
and Mn-rich coatings of foraminifera shells; not as a primary
constituent of the shell matrix [3]. Here, we analyze the P/Ca
ratios in shells of four species of planktonic foraminifera
(Orbulina universa, Globigerinoides sacculifer,
Globigerinoides ruber, and Globorotalia menardii) and their
relationship to seawater PO₄, dissolved organic P (DOP), and
total dissolved P (TDP) in the Carriaco Basin. The Carriaco
Basin is characterized by intense seasonal upwelling, making
it an ideal location to test if the P/Ca ratio of foraminiferal
calcite reflects nutrient availability of surrounding waters.
Samples are from bi-weekly sediment trap samples collected
in the eastern Carriaco Basin (10° 30'N, 64° 40'W) during
2005–2007. Water column phosphorus profiles were collected
monthly. Concentrations of P within the foraminiferal shells
ranges from 0.177 - 3.799 and varies between species. P/Ca
range from 0.208 - 0.962 in O. universa, 0.177 - 0.775 in G.
sacculifer, 0.442 - 3.799 in G. ruber, and 0.264 - 1.706 in G.
menardii with the highest values occurring in January during
winter upwelling and in June – August during secondary
upwelling. The P/Ca ratios in O. universa and in G. ruber are
positively correlated with PO₄ (r² = 0.40, p = 0.009; r² = 0.61,
p = 0.023 respectively). In contrast, P/Ca ratios in G.
sacculifer and G. menardii are not. Furthermore, there are no
significant correlation between the P/Ca ratios of any of the
species and DOP and TDP, suggesting that the foraminifera
only incorporate PO₄ into their shells during growth.

1861-1866.