Radon-222 Determination of CO_2 and Trace Gas Exchange Rates Between Forest Canopies and the Troposphere in Brazilian Amazonia

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Continuous in situ measurements of radon-222 in forest canopy air and across the soil-air interface are combined to quantify canopy air exchange rates and trace gas fluxes with the troposphere in Amazonian terre firme forest near Santarém, Pará, Brazil. Radon detector arrays deployed since April, 2000 on 65 m towers at primary forest, selectively logged, and pasture sites in or near the Tapajos National Forest can accurately resolve 0.01 pCi/l/m radon activity gradients within forest canopies using 15 minute counting intervals. Canopy and above-canopy air radon activities at up to ten tower elevations decrease systematically with height above the soil surface and range from >2.0 pCi/l (0.3 m elevation) to <0.05 pCi/l (64 m elevation). Diel forest canopy radon variations exhibit dual maxima peaking at approximately 0900 and 1700 local time occurring as a result of nocturnal stratification as well as late afternoon stratification events respectively. Radon concentration profiles at the pasture site are controlled by the dynamics of nocturnal and boundary layer formation. Radon inventories within the lower 10m of the forest canopy typically range by more than 300 percent over a diel cycle. Soil-air radon fluxes are determined using portable radon fluxometers capable of repeated sixty minute flux measurements on soil collars installed around the tower sites. The radon data can be used to calculate an overall canopy gas exchange coefficient (k_z) using source-sink mass balance equations or eddy diffusivities (K_z) as a function of height.from radon flux divergence. These constants are combined with CO_2 and trace gas canopy inventory data to calculate gas trace gas sources and sinks within the canopy and exchange rates with the atmosphere averaged over 30 minute periods.

Acapulco recorded an early asteroidal heat pulse

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We report new chronological data which refine the evolutionary model of an initially chondritic, partially melted planetesimal [1] which cooled fast and retained nitrogen isotopic disequilibrium between metal and silicate phases, ranging from $\delta^{15}N = -150^o/_{oo}$ in metal matrix and graphites [2] to $+15^o/_{oo}$ in silicates. Metal inclusions in opx are only partially equilibrated. Xe isotopic records show that a major trapped Xe component of OC-Xe composition, located in metal-rich inclusions in orthopyroxene, assimilated a radiogenic ^{129}Xe component corresponding to only ~10% decay of ^{129}I at the time of system closure. The ^{129}I-^{129}Xe records in feldspar [3] indicate a closure time 5.0 Ma earlier than for apatites, which closed for Pb 4.557 Ga ago [4]. The measured ratio $^{129}I/^{127}I$=0.909 at the time of closure for Xe in feldspar, when compared to a $^{129}Xe/^{132}Xe$ ratio of 1.057, imply a system closure ~6 Ma after formation of the meteorite, assuming radiogenic ^{129}Xe evolution in a closed system. This chronology suggests a time of formation 4.568 Ga ago, consistent within uncertainties with formation times of chondrites. The ^{53}Mn-^{53}Cr age of 4.555 Ga [5] is consistent with the Pb-Pb age and both ages are consistent with fast cooling rates (~100K/Ma) for Acapulco as inferred from ^{129}I-^{129}Xe. The evidence for much slower cooling based on ^{39}Ar-^{40}Ar ages and fission track retention in phosphates [6] is controversial. A series of individual phosphate grains (150-250μm size) were dated by (U,Th)/He method [7]. The inferred low closure temperature of ~110ºC makes the method suitable for tests of the cooling rates at low temperatures. Five of the phosphate crystals yield old ages, identical with the Pb-Pb age within uncertainties, suggesting rapid cooling to ~110ºC. Younger ages for other phosphates show evidence for incomplete retention of ^{4}He. The (U,Th)/He ages do not support slow cooling rates inferred from fission tracks.

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