Deuterium isotopic exchangeability of resin and amber at low thermal stress under hydrous conditions

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Hydrous deuterium-exchange experiments have shown that a significant fraction of the original D/H composition of bulk kerogens, bitumens and expelled oils may participate in isotopic exchange reactions during burial diagenesis. However, it is unknown to what extent plant-derived secondary metabolites, namely resins and their fossil counterpart amber, exchange hydrogen isotopes following their biosynthesis. This situation hinders the application of resin D/H measurements in paleoenvironmental reconstruction. Here, we assess explicitly hydrogen exchange in resins and ambers using a series of immersion experiments in deuterated (D-enriched) waters over a period of several months at several temperatures. We are especially interested in assessing whether significant H-isotopic exchange occurs between resins and meteoric waters during early thermal maturation and polymerization. At 90°C, equivalent to ~3km of burial in most diagenetic regimes, modern conifer and angiosperm resins have an average post-metabolic H exchange of 4.6%, compared to only 1.1% for mature, polymerized ambers. At 55°C the degree of exchange is considerably lower: 1.9% for resins and 0.6% for ambers. These results indicate that most D/H isotopic exchange occurs prior to polymerization reactions, thereby confirming that D/H measurements from amber constitute a potentially sensitive proxy for environmental change.