INTRODUCTION

Ambers are the result of millions of years of fossilization of terpenoid compounds in tree resins. The analysis of the organic extract of ambers has been used to identify the different types of terpenes from monoterpenes, sesquiterpenes, diterpenes, and triterpenes. The terpene composition of ambers can reveal information on the possible botanical source of the ambers, as well as the environment conditions and geographical distribution of extinct tree species. Triterpenes (C30) are most frequently present in dammar resins from trees of the Dipterocarpaceae family, a family of trees common to Southeast Asia and India that thrive in tropical environments (1-3). Amber samples that are abundant in triterpenes usually lack diterpenes (C20). Therefore, ambers that have diterpenes are unlikely to come from dammar resins and have been attributed to several other possible botanical sources.

Two analytical techniques, gas chromatography-mass spectrometry (GC-MS) and infrared spectroscopy (FTIR), were used to study four geological amber samples from Arkansas. FTIR spectroscopy was used to characterize the ambers by comparing spectra to an in-house database of IR spectra of ambers with known geological origin.

EXPERIMENTAL METHODOLOGY

GC-MS ANALYSIS

Amber samples were extracted with ethyl ether (CH₃CO₂Et) (1:1 v/v) and methylated with diazomethane to convert the terpene acids to methyl esters. Methylation improves the GC detection of terpenoid compounds. The methylated samples were analyzed by GC-MS using Agilent Technologies 6890 GC/5973 MS model fitted with a Hewlett Packard poly (methyl silicone) capillary column set to the following parameters: injection port at 250°C, electron impact at eV, and column from 50-250°C at 5°C/minute. Terpenes were identified by comparison to previous studies, the NIST library, and information from primary literature.

FTIR SPECTROSCOPY

The four Arkansas ambers were analyzed using Thermo Nicolet FTIR spectrometer model Nexus 670. The samples were prepared as KBr pellets.

RESULTS AND DATA ANALYSIS

FTIR SPECTROSCOPY ANALYSIS

The FTIR spectra of the Arkansas ambers (a representative example in Figure 2) shows peaks consistent with an organic composition typically seen for ambers: saturated CH stretches and bends, and ester linkages (C=O and C-O). Another Arkansas amber from the Acme Brick Co. Pit 1, which was previously studied in the Amber Research Laboratory, showed good overlap with the FTIR spectra of the Acme Brick Co. pit and Arkansas-4 ambers in Figure 2, showing that both correspond very well.

A review of the literature provides further confirmation that the Arkansas ambers studied here are likely from the Acme Brick Co. Pit (2). The Acme Brick Co. ambers were classified as Claiomine ambers, fossilized resin that very likely came from tropical hardwood trees (2). The IR for the Claiomine amber in Figure 3 compares very well with the FTIR spectra in Figure 2.

DISCUSSION AND CONCLUSION

Based on GC-MS and FTIR analysis all four Arkansas ambers in this project are very similar. They are clearly triterpene-based ambers, a peculiar chemical composition for this region as most ambers are diterpene ambers. Finally, based on FTIR analysis, there is strong evidence that the Arkansas ambers studied in this project are most likely Claiomine ambers from the same site as the Acme Brick Co. pit.

ACKNOWLEDGMENTS + REFERENCES

We are extremely grateful to our URSI sponsor, Riverford Kanzler, who supported the Omated Internship. We would like to thank Virginia Frieden for collaborating with the Amber Research Laboratory and the supply of the four amber samples from Arkansas. We also acknowledge Brandon Malvin VC/23 and Linnea Martin VC/21 for their initial work on the project.