Late Cenozoic Continental Flood Basalt Volcanism in the Arabian Shield: The Harrat Rahat Volcanic Field

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The Harrat Rahat Volcanic Field is characterized by northward migration of oceanic island basalt (OIB) volcanism and initiation of continental rifting in the western portion of the Arabian plate. It contains much scoria cones, shield volcanoes and domes arranged in linear clusters that represent four centers of eruptive activity. These are not related to the NNW opening of the Red Sea, but represent a new N-S crustal rift (10 million years ago). The spatial and temporal distribution of basaltic lavas show the abundance of (OTB) and (AOB) lavas, followed by hawaiite, mugearites, benmoreites, and trachytes. In most of the early OTB lava flows only olivine was fractionated from magma prior to eruption. Major and trace elements data show the consistency with magma evolution dominated by fractional crystallization of phenocrysts phases with evidence of polybaric processes. However, crustal contamination probably played a minor role in the evolution of OTB, AOB and hawaiite lavas. The more evolved mugearite and benmoreite lavas have relatively homogenous Sr and Nd isotopic ratios. The most evolved trachytes have low $^{87}Sr/^{86}Sr$ ratios 0.704170-0.704516 (isotopic similarity with parental mantle), while the trachytes have very high $^{87}Sr/^{86}Sr$ ratios of 0.707472-0.707485 (combination of fractional crystallization and magma mixing). The OTB, AOB and hawaiite lavas display chemical signatures of upwelling mantle plume or OIB-type source with strong enrichment in Cs, Rb, Ba, Th, U, K, Nb, Ta and LREE. The $^{87}Sr/^{86}Sr$ (0.702985-0.705186), $^{143}Nd/^{144}Nd$ (0.512889-0.513033), and $^{206}Pb/^{204}Pb$ (18.525-19.382), $^{207}Pb/^{204}Pb$ (15.521-15.739) and $^{208}Pb/^{204}Pb$ (38.064-39.111) ratios of basaltic rocks from the HRVF are similar to those of the OIB-type plume source basalts. Data indicates that they probably derived by mixing of: OIB-type, deep mantle plume source and followed by a shallow asthenosphere