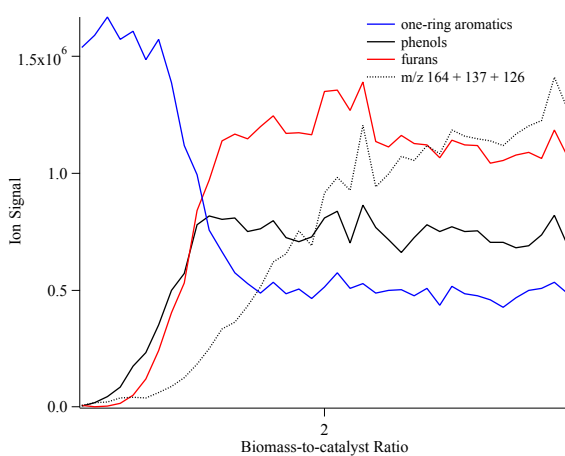
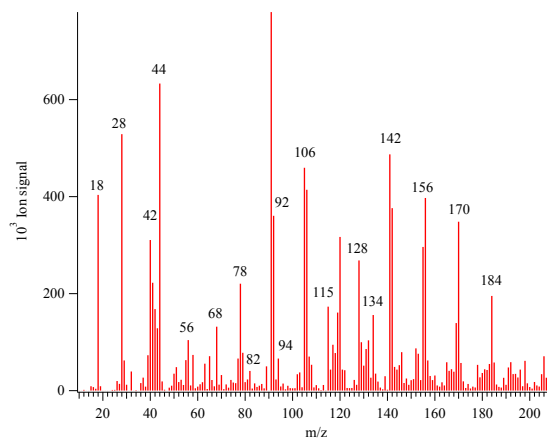


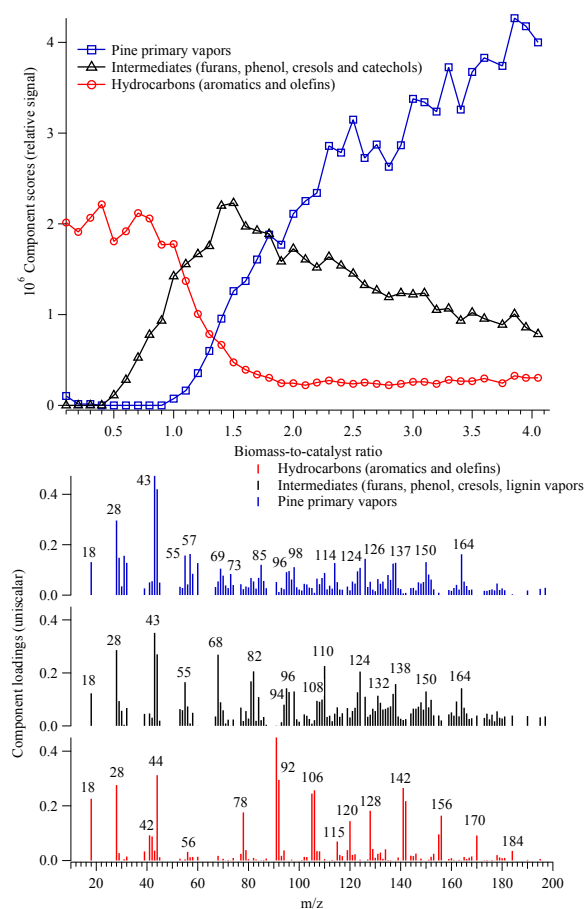
**Figure S1.** Trends of upgraded vapors during pyrolysis of 40 boats of pine and the vapors passed through 0.5 g fixed bed of  $\beta$ -zeolite (SAR 25).



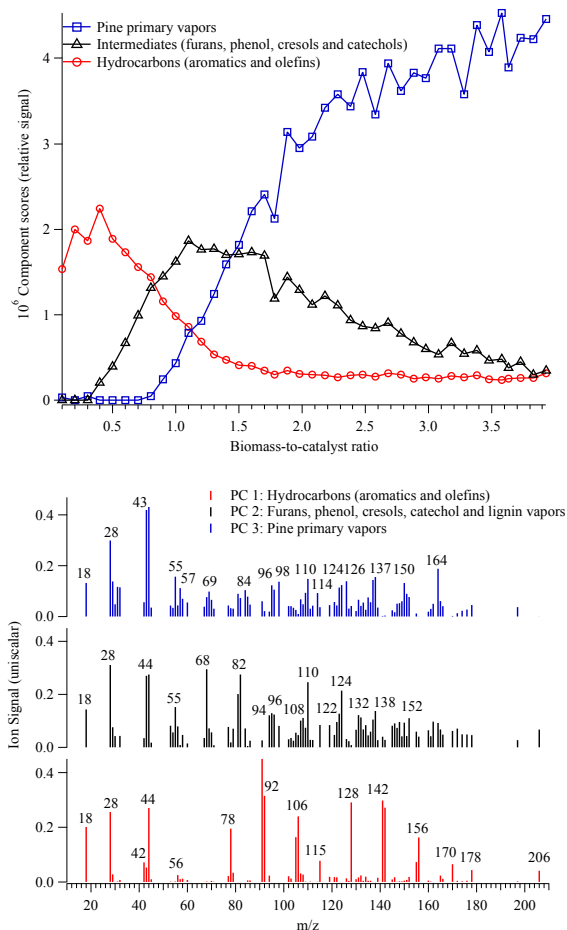
**Figure S2.** Trends of upgraded products, intermediates and primary vapors during pyrolysis of 40 boats of pine and the vapors passed through a fixed bed of 0.5 g  $\beta$ -zeolite (SAR 25).



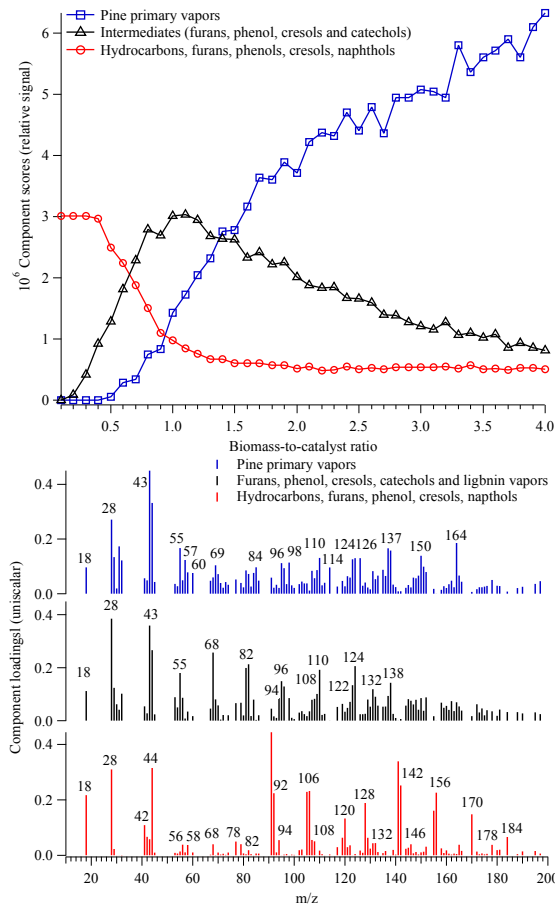
**Figure S3.** Averaged mass spectra for pyrolysis and upgrading of pine vapors recorded from boat 1 ( $\beta$ -zeolite with SAR 250).



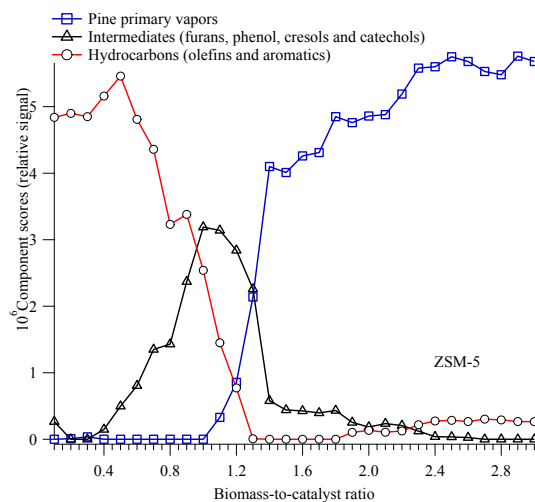
**Figure S4.** Multivariate analysis of a deactivation study of SAR 21  $\beta$ -zeolite during upgrading of pine pyrolysis vapors. The top plot shows the component scores as a function of biomass-to-catalyst ratio. The reconstructed spectra for each pure component (PC 1 to PC 3) are shown in the lower plot.



**Figure S5.** Multivariate analysis of a deactivation study of SAR 38  $\beta$ -zeolite during upgrading of pine pyrolysis vapors. The top plot shows the component scores as a function of biomass-to-catalyst ratio. The reconstructed spectra for each pure component (PC 1 to PC 3) are shown in the lower plot.



**Figure S6.** Multivariate analysis of a deactivation study of SAR 75  $\beta$ -zeolite during upgrading of pine pyrolysis vapors. The top plot shows the component scores as a function of biomass-to-catalyst ratio. The reconstructed spectra for each pure component (PC 1 to PC 3) are shown in the lower plot.



**Figure S7.** Multivariate analysis of a deactivation study of HZSM-5 during upgrading of pine pyrolysis

vapors. The plot shows the component scores as a function of biomass-to-catalyst ratio.