and Y73S, respectively), suggesting substantial decreases in the conformational stability of the mutant PLA2s. However, the fact that the mutants can still undergo cooperative denaturation distinguish them from real molten globules.6,7,8

It is striking that both Tyr-73 and Asp-99 are part of the conserved "catalytic network"9,10 at the active site; the two side chains are connected by a hydrogen bond, and Asp-99 is further H-bonded to the general base His-48. It is even more striking that the highly flexible mutants are still functional, though with activities diminished 10-100-fold.11,12 Although the latter is expected for active site mutants, our results only allow us to conclude that the two residues play critical structural roles; their functional roles remain to be established.

One should not be led to think that the structure of PLA2 is "fragile". None of the site-specific mutations at seven other conserved positions (Tyr-52, Lys-53, Lys-56, Phe-22, Phe-106, Cys-51, and Cys-98) resulted in large structural perturbations. The Y52V (Tyr-52 is also H-bonded to Asp-99) PLA2 showed activity similar to WT,22 but strikingly similar NOESY spectra relative to the WT enzyme.12 The double mutant C51A/C98A, activity similar to Y73S, but strikingly similar NOESY spectra containing-aromatic interactions along with Phe-5 in the crystal structure,13 resulted in small and localized changes in NOESY spectra.

The disappearance of NOEs could be caused by either decreased $r_1$ (such that $\omega r_1 \approx 1$) or increased average internuclear distances. Other approaches are being undertaken to differentiate these possibilities, to uncover structural basis for the observed effects, and to determine if the conformations are induced back upon binding to micelles.

Radical Scavenging in Zeolite Media

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The model of the solvent cage predicts that the dynamics of dissociating particles in fluid media depends on their probabilities of escape and recombination1,2 and that there may be at least three potentially observable stages at which scavenging may occur: (a) primary geminate pairs, (b) secondary geminate pairs, and (c) free radicals.3

Experimental tests3,4 have demonstrated scavenging at stages b and c. However, because of the restricted time resolution available within the dynamics of fluid systems, distinctive scavenging at each intermediate stage has not proven possible.4 The general concepts of cage effects in liquids have been applied to the dynamic properties of organized media and constrained environments.5 In this communication, we report an example where...
Photolysis experiments were carried out with three different loadings of DBK-d5 and eight different oxygen pressure values (Figure 1a-d). Product mixtures were found to contain DPE-(do, DMBP-ds), Oxides-I to -IV. The first scavenging step (at ~10^{-1} Torr O_2) in the curves of Figure 1a monitors the interception of free radicals (i.e., e_1 vs s_1) giving rise to benzaldehyde and benzoic acid. This results in an increase in the fraction of secondary geminate pairs undergoing combination [percentage of geminate DPE (DPE-d5) in Figure 1b] and a decrease of the total yields of DPE by scavenging of the radicals undergoing random encounters (Figure 1c). The amplitude of the first step in the curves in Figure 1a reflects the fraction of geminate pairs that ultimately become free radicals (ca. 0.5 at (S) = 0.16 and ca. 0.1 at (S) = 0.48 and (S) = 0.64). The experimental uncertainty in the first scavenging step of curve 1 is largely reduced in Figure 1b where the percentage of geminate DPE remaining also reflects the fraction of free radicals scavenged.

Scavenging of Secondary Geminate Radical Pairs. An increase in the amount of oxygen results in the onset of a competition of scavenging with recombination and reaction of the secondary radical pair [e_2 vs s_2; Oxides-III, Scheme I]. Oxidation products at this step consist of benzaldehyde and benzoic acid. Scavenging in the global environment of interconnected supercages is manifested both in terms of decreased yields of DPE and increased yields of P_R. However, in this region, little effect is observed in the yields of isomeric products (e_3 > s_3 and e_3 > s_3). The fraction of radicals scavenged at this stage from Figure 1a,c are ca. 0.1 and 0.05 at (S) = 0.48 and 0.64, respectively.

Scavenging of the Primary Geminate Radical Pair. Combination of the primary radical pair in the secondary cages yields isomeric stages (n). The primary cage is the site where a geminate radical pair is created (a zeolite supercage). Escape of a radical to neighboring sites follows by a geminate re-encounter constitutes a secondary cage. Finally, randomization of radical pairs into the supertite network generates free radicals which tend to be scavenged by random encounters and combinations. Two consecutive geminate radical pairs of different composition are involved in our system: the primary geminate radical pair (ACO-B) and the secondary geminate radical pair (A'B) resulting from decarbonylation. While the formation of the secondary radical pair could occur in the primary or secondary cages or even after randomization of the pair, our investigations indicate that the conversion of ACO-B into A'B in zeolite NaX occurs at the second stage, as indicated in Scheme 1.

The absence of oxygen, evolution of the radical intermediates depends on the rates of escape (e) and combination (c). In the zeolite lattice, the former are determined by the percolation of the radicals through the unoccupied supercage network and depend on the amount of DBK (loading level) in the system. The effect of oxygen as a scavenger will depend on its concentration and its ability to intercept intermediates before escape to the next level occurs.
products with a $p$-MAP/o-MAP = 0.3 ratio (Isomers II). We have proposed that these products are formed from radicals escaping the primary cage but that are unable to percolate through the lattice and are forced to reencounter. The lifetime of this pair is determined either by decarbonylation ($e_0$) or by reencounter and reaction ($e_2$, Scheme 1), and the largest scavenging effects are observed on the yield of isomerization products and on the yields of oxides, which include the formation of phenylacetic acid (Oxides-II). The amplitude between the last two points in lines m and h of Figure 1a,d at pressures approaching $10^3$ Torr reflects the fraction of radicals involved at this stage. Finally, at the end of the scavenging dynamics is the primary radical pair in the primary cage. The nonscavenging products remaining at high pressures (Isomers-I) come from reactions at the primary geminate site (supercage) and are characterized by $p$-MAP/o-MAP = 0.15 with ($S$) = 0.64 and 0.48 at the highest oxygen pressures.

Although the dynamics of the radical pairs produced from photolysis of DBK in solution basically occurs in a succession of unresolvable steps, the conditions for time management in complex chemical and molecular dynamics not available in fluid media may be found in organized media such as zeolites.

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Experimental and Theoretical Evidence in Support of an Intermediate Complex in the Insertion Reaction of Silylene into Silane

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The reaction between silylene, SiH₂, and silane, SiH₄, viz.

$$\text{SiH}_2 + \text{SiH}_4 \rightarrow \text{SiH}_6$$

(1)

may reasonably be considered the prototype Si-H insertion process of silicon hydride chemistry. This reaction, which is also the second step in the thermolysis of silane leading ultimately to solid silicon and silicon hydride deposition, is known to be fast. Experimental measurements of the rate constant have shown the reaction to proceed at close to the collisional limit. Theoretical calculations of the energy surface for the decomposition of SiH₆ show that it possesses no energy barrier at the threshold of dissociation, which suggests a zero barrier for reaction 1. The published kinetic studies of reaction 1 have only been carried out at room temperature. We present here experimental rate measurements of reaction 1 in the gas phase over the temperature range 296-658 K, supported by ab initio calculations which provide unambiguous evidence for a barrierless reaction and additionally suggest the existence of a weakly bound complex in the reaction potential entrance channel.

SiH₂ kinetic studies have been carried out by the laser flash photolysis technique, the details of which have been published previously. SiH₂ was created by photodecomposition of phenylsilane using the 193-nm ArF line of a pulsed excimer laser. SiH₂ was detected and monitored in real time by use of a sinusoidal dye laser tuned to a known (strong) vibration-rotation band. Absorption signal decays from 5-15 photolysis laser shots were averaged and found to give good first-order kinetic fits. Experiments were carried out with gas mixtures containing a few millitorr of phenylsilane, varying quantities of SiH₄ up to 100 mTorr, and inert diluent bath gas at total pressures between 1 and 100 Torr. Second-order kinetics was confirmed by finding a linear dependence of the pseudo-first-order decay constant on substrate SiH₂ pressures. Experiments were carried out with gas mixtures containing a few millitorr of phenylsilane, varying quantities of SiH₂ up to 100 mTorr, and inert diluent bath gas (SF₆ or Ar) at total pressures between 1 and 100 Torr. Second-order rate kinetics was confirmed by finding a linear pressure dependence of the pseudo-first-order decay constants on substrate SiH₂ pressures. The reaction was studied at six temperatures in the range 296-653 K. Second-order rate constants were found to be pressure

<p>| Table I. Experimental Rate Constants for Reaction 1 at Different Temperatures (Bath Gas SF₆) |</p>
<table>
<thead>
<tr>
<th>T/K</th>
<th>$P = 10$ Torr</th>
<th>$P = \infty$</th>
</tr>
</thead>
<tbody>
<tr>
<td>296</td>
<td>4.2</td>
<td>4.6 ± 0.3</td>
</tr>
<tr>
<td>363</td>
<td>3.3</td>
<td>3.9 ± 0.3</td>
</tr>
<tr>
<td>432</td>
<td>2.9</td>
<td>3.2 ± 0.3</td>
</tr>
<tr>
<td>488</td>
<td>1.90</td>
<td>2.6 ± 0.3</td>
</tr>
<tr>
<td>578</td>
<td>1.28</td>
<td>2.6 ± 0.4</td>
</tr>
<tr>
<td>658</td>
<td>0.72</td>
<td>2.2 ± 0.4</td>
</tr>
</tbody>
</table>

* Obtained by extrapolation.

Figure 1. Pressure dependence of second-order rate constants for reaction 1 at different temperatures [* ,296 K; ○, 363 K; ★, 432 K; ●, 488 K; □, 578 K; ×, 658 K]. Solid lines are variational RRKM theoretical fits.

![Figure 1](image-url)