Supplementary Information

Redox-Based Defect Detection in Packed DNA: Insights from Hybrid Quantum Mechanical/Molecular Mechanics Molecular Dynamics Simulations

Murat Kılıç[†], Polydefkis Diamantis[†], and Ursula Rothlisberger[*]

Laboratory of Computational Chemistry and Biochemistry, Institute of Chemical Sciences and Engineering, École Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland

E-mail: ursula.roethlisberger@epfl.ch

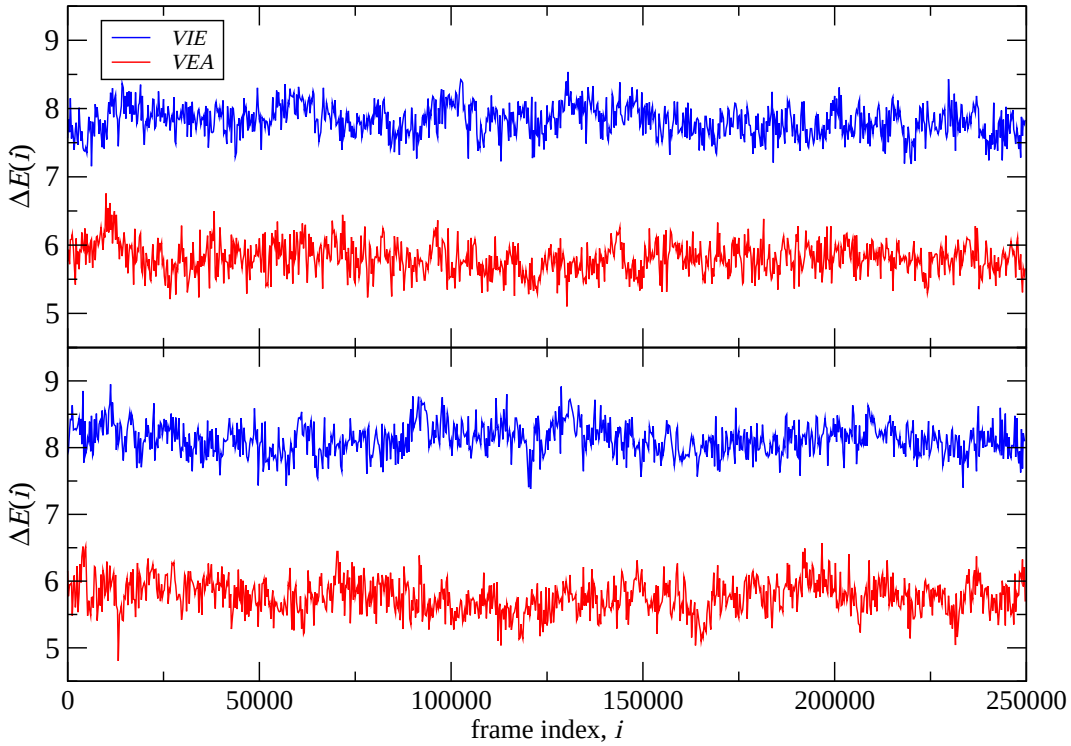

Figure 1: Time series of the vertical ionization energies (*VIE*s) and vertical electron affinities (*VEA*s) used for the determination of the vertical energy gap distributions and redox properties of the native G-rich **regions 1** (**top**) and **2** (**bottom**).

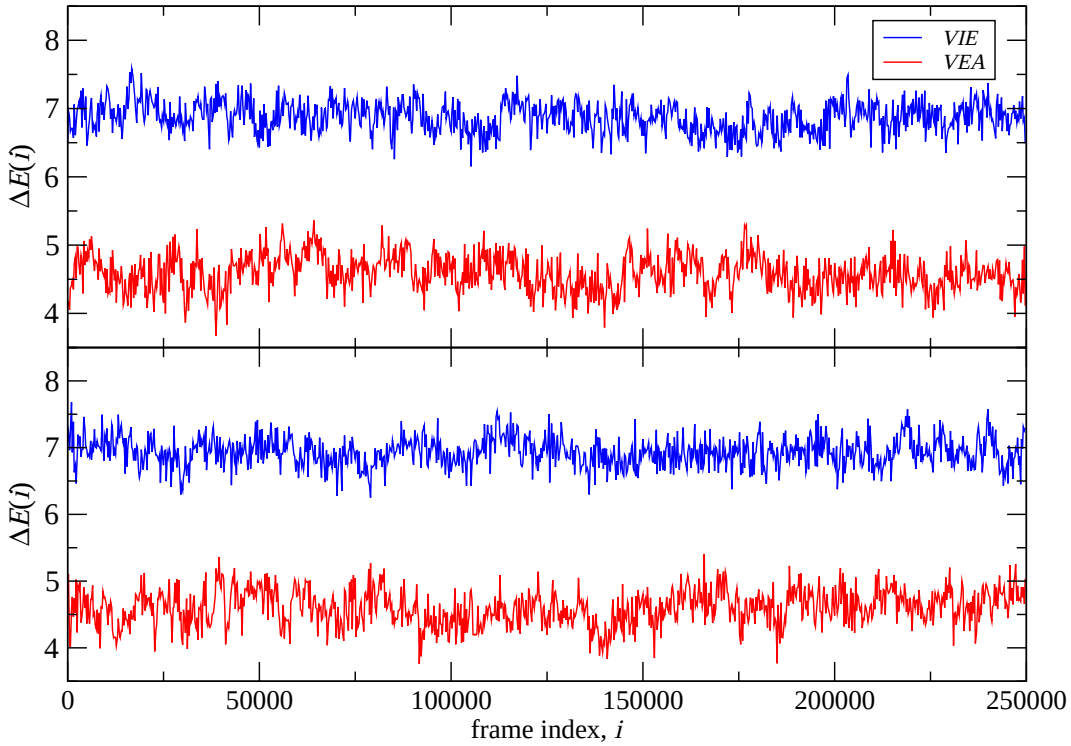

Figure 2: Time series of the *VIE*s and *VEA*s used for the determination of the vertical energy gap distributions and redox properties of the defect systems in which the 8-oxoguanine (8oxoG) base was placed in G-rich **regions 1** (**top**) and **2** (**bottom**).

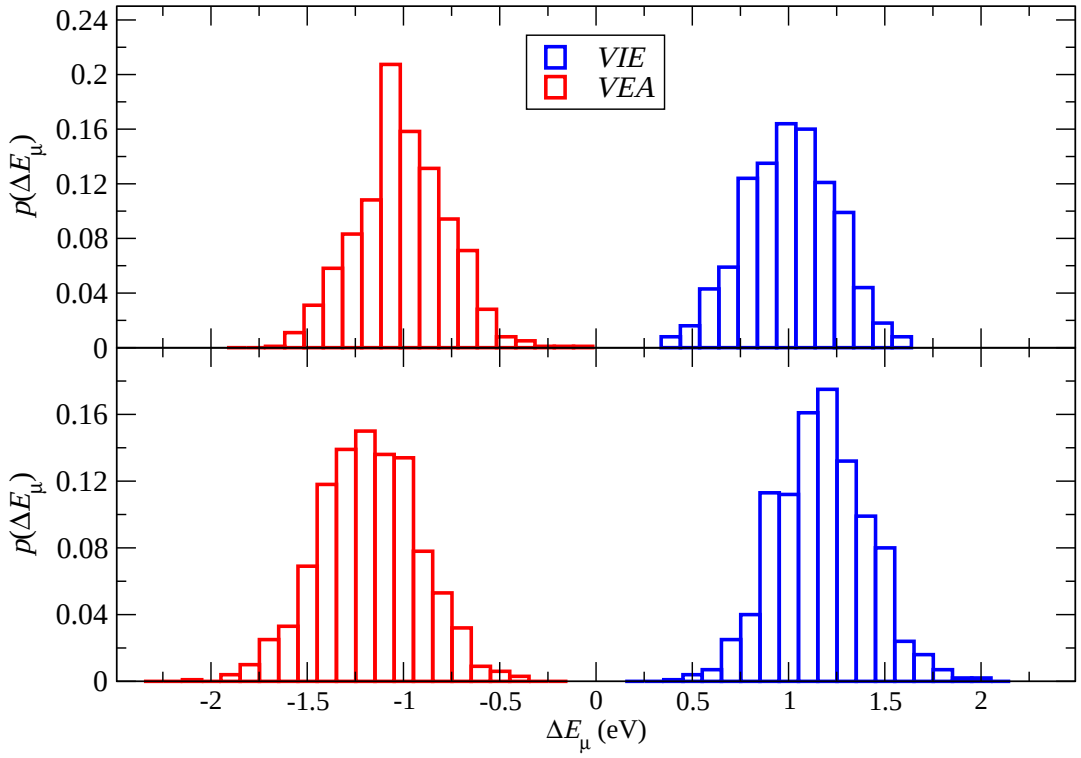

Figure 3: *VIE* and *VEA* distributions for the native G-rich **regions 1** (**top**) and **2** (**bottom**).

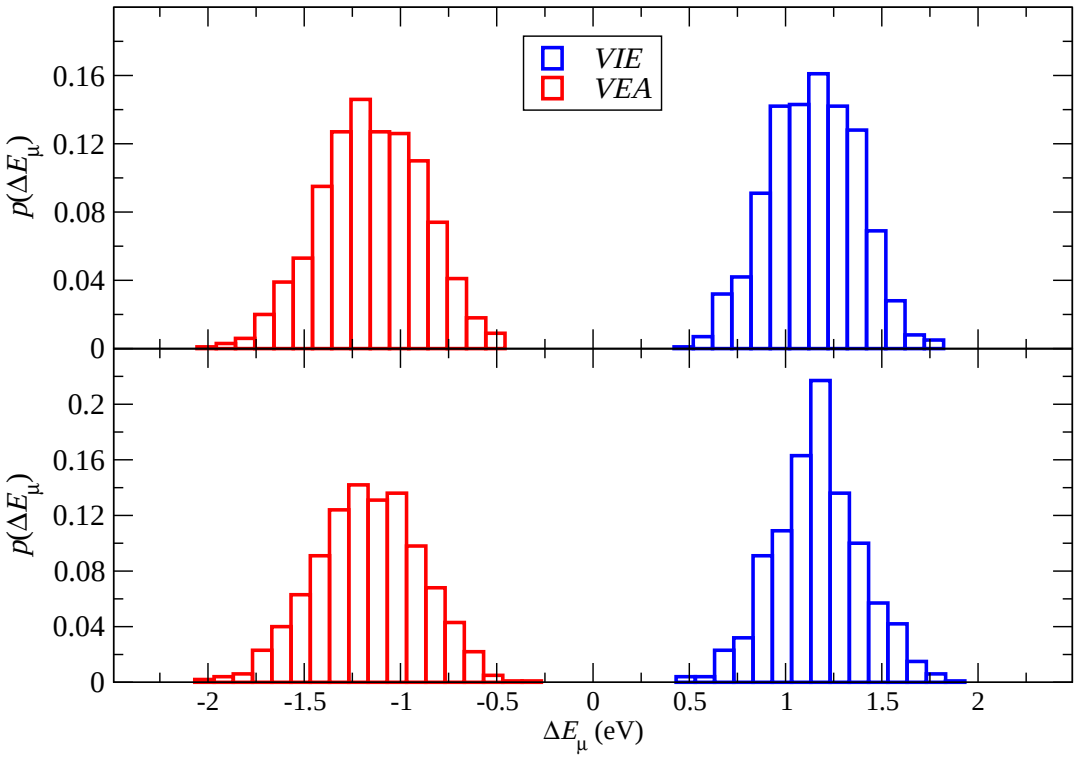

Figure 4: *VIE* and *VEA* distributions for the defect systems in which 8oxoG was placed in in G-rich **regions 1** (**top**) and **2** (**bottom**).

Table 1: G-rich **region 1** systems: Root mean square fluctuations (RMSFs) for the DNA residues belonging in the QM region of the native (left) and 8oxoG-containing (right) systems.

Native				8oxoG			
Reduced		Oxidized		Reduced		Oxidized	
ResID	RMSF (Å)	ResID	RMSF (Å)	ResID	RMSF (Å)	ResID	RMSF (Å)
58	0.46	58	0.47	58	0.43	58	0.44
59	0.44	59	0.40	59	0.46	59	0.39
60	0.43	60	0.40	60	0.48	60	0.41
233	0.58	233	0.45	233	0.47	233	0.43
234	0.55	234	0.40	234	0.50	234	0.61
235	0.51	235	0.61	235	0.63	235	0.54

Table 2: G-rich **region 2** systems: Root mean square fluctuations (RMSFs) for the DNA residues belonging in the QM region of the native (left) and 8oxoG-containing (right) systems.

Native				8oxoG			
Reduced		Oxidized		Reduced		Oxidized	
ResID	RMSF (Å)	ResID	RMSF (Å)	ResID	RMSF (Å)	ResID	RMSF (Å)
87	0.52	87	0.58	87	0.46	87	0.49
88	0.48	88	0.48	88	0.42	88	0.40
89	0.53	89	0.48	89	0.44	89	0.39
204	0.67	204	0.45	204	0.42	204	0.50
205	0.44	205	0.45	205	0.38	205	0.44
206	0.56	206	0.44	206	0.43	206	0.48

Table 3: G-rich **region 1** systems: QM-treated DNA and neighboring protein residues sharing a strong intermolecular interaction in the native (left) and 8oxoG-containing (right) systems.

Native				8oxoG			
Reduced		Oxidized		Reduced		Oxidized	
ResID_{DNA}	$\text{ResID}_{Pro.}$	ResID_{DNA}	$\text{ResID}_{Pro.}$	ResID_{DNA}	$\text{ResID}_{Pro.}$	ResID_{DNA}	$\text{ResID}_{Pro.}$
58	–	58	–	58	–	58	–
59	–	59	–	59	–	59	318
60	407	60	401 / 407	60	318 / 401	60	318 / 407
233	–	233	–	233	–	233	–
234	–	234	–	234	–	234	–
235	391	235	–	235	–	235	–

Table 4: G-rich **region 2** systems: QM-treated DNA and neighboring protein residues sharing an intermolecular interaction in the native (left) and 8oxoG-containing (right) systems. With the exception of a strong (206-731) and a weak (204-688) interaction found for for the oxidized native system, no intermolecular interactions were identified.

Native				8oxoG			
Reduced		Oxidized		Reduced		Oxidized	
ResID_{DNA}	$\text{ResID}_{Pro.}$	ResID_{DNA}	$\text{ResID}_{Pro.}$	ResID_{DNA}	$\text{ResID}_{Pro.}$	ResID_{DNA}	$\text{ResID}_{Pro.}$
87	–	87	–	87	–	87	–
88	–	88	–	88	–	88	–
89	–	89	–	89	–	89	–
204	–	204	688	204	–	204	–
205	–	205	–	205	–	205	–
206	–	206	731	206	–	206	–

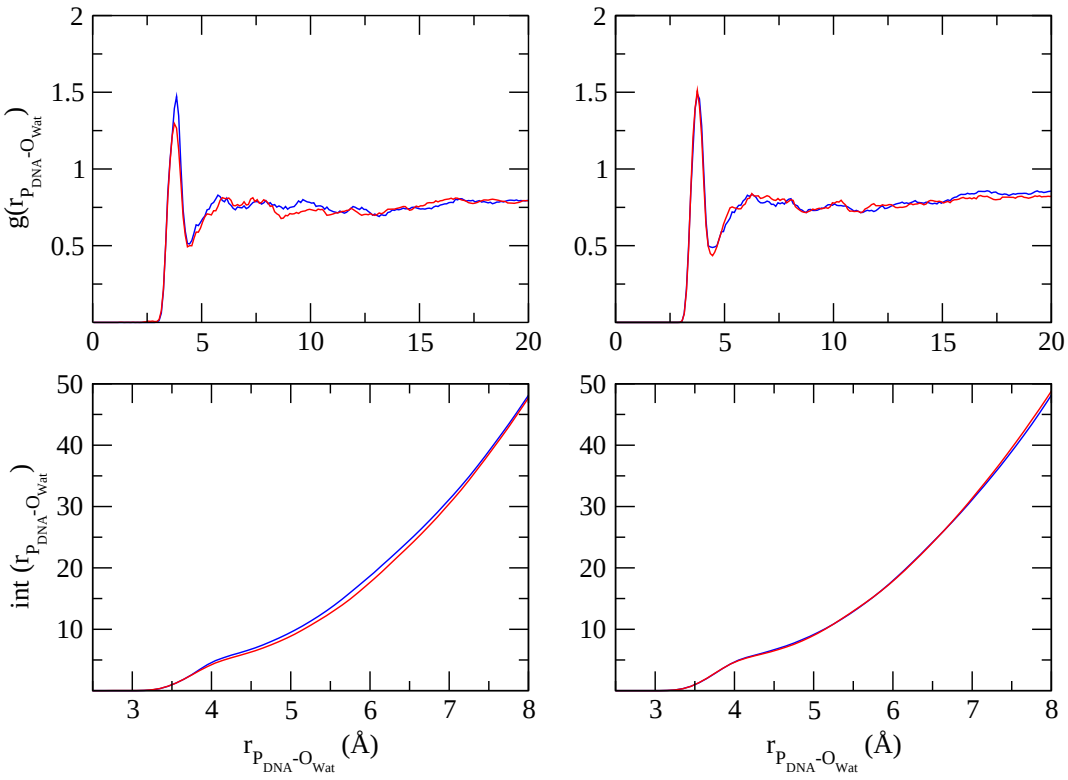

Figure 5: QM DNA-water radial distribution functions g($r_{P-O_{wat}}$), (top) and integrals (bottom) for the P and O_{wat} atoms, for the reduced state (blue colour) and oxidized state (red colour) of the native (left) and defect system (right) of **region 1**.

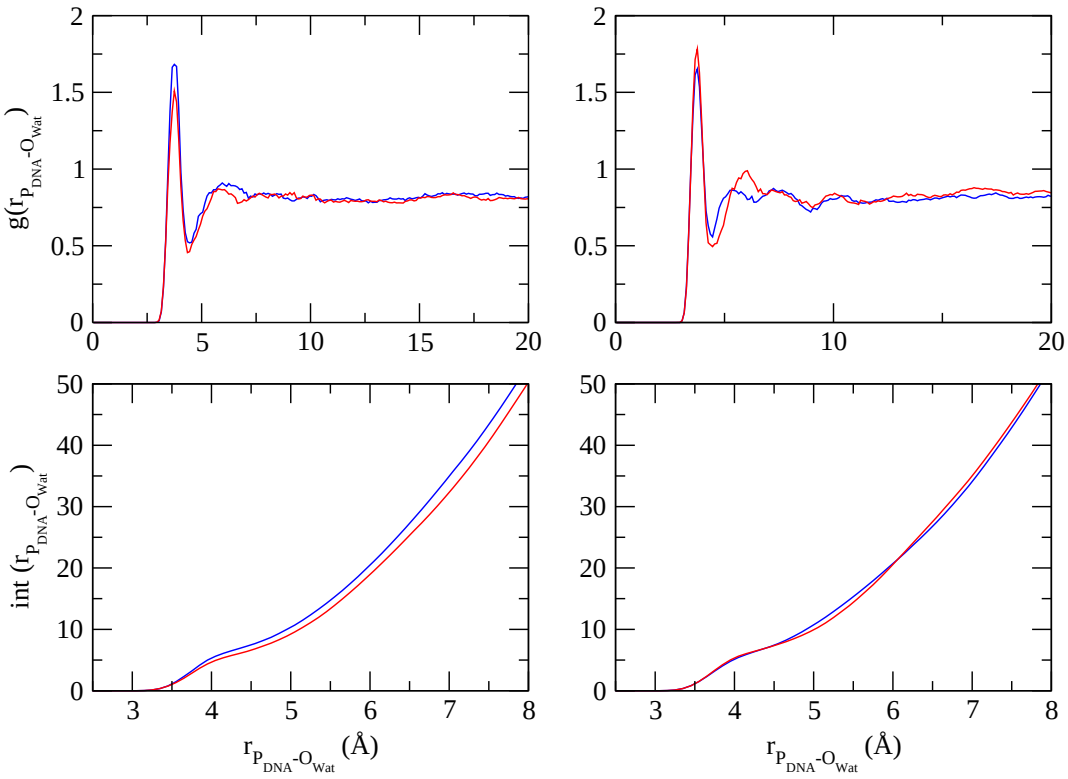

Figure 6: QM DNA-water radial distribution functions g($r_{P-O_{wat}}$), (top) and integrals (bottom) for the P and O_{wat} atoms, for the reduced state (blue colour) and oxidized state (red colour) of the native (left) and defect system (right) of **region 2**.

Author Contributions

† Murat Kılıç and Polydefkis Diamantis contributed equally to the presented work and the preparation of this manuscript.