

Bioremediation of soils saturated with spilled crude oil

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Table S1.

Minor hydrocarbonoclastic bacteria in oil-saturated soil (OSS) and OSS diluted (with pristine desert soil: I, 1 kg OSS + 0.25 kg; II, 1 kg OSS + 0.5 kg; III, 1 kg OSS + 0.75 kg) during bioremediation (shaded areas in Pie charts in Fig. 1 and 2).

End of month	Oil-saturated soil (OSS)	Diluted with pristine desert soil			Diluted with pristine garden soil		
		I	II	III	I	II	III
0 March	<i>Dietzia maris</i>	<i>Cellulomonas iranensis</i>	<i>Pseudomonas songnenensis</i>		<i>Pseudomonas songnenensis</i>	<i>Lentzea chajnantorensis</i>	
	<i>Streptomyces gulbargensis</i>	<i>Pseudomonas songnenensis</i>	<i>Streptomyces griseoflavus</i>			<i>Microbacterium paludicola</i>	
	<i>Williamsia marianensis</i>	<i>Rhodococcus gordoniae</i>	<i>Williamsia marianensis</i>			<i>Rhodococcus erythropolis</i>	
	<i>Nocardioides albus</i>	<i>Streptomyces griseoflavus</i> <i>Streptomyces scopiformis</i> <i>Williamsia marianensis</i>	<i>Actinotalea ferrariae</i>				
1 April	<i>Agromyces iriomotensis</i>	<i>Gordonia hankookensis</i>	<i>Streptomyces maoxianensis</i>	<i>Pseudomonas knackmussii</i>	<i>Arthrobacter agilis</i>	<i>Kocuria turfanensis</i>	<i>Arthrobacter echini</i>
	<i>Bacillus circulans</i>	<i>Pseudarthrobacter phenanthrenivorans</i>	<i>Streptomyces maoxianensis</i>	<i>Pseudomonas songnenensis</i>	<i>Arthrobacter ginsengisoli</i>		<i>Arthrobacter ginsengisoli</i>
	<i>Gordonia hankookensis</i>	<i>Streptomyces youssoufiensis</i>	<i>Streptomyces maoxianensis</i>	<i>Williamsia marianensis</i>			<i>Dietzia maris</i>
	<i>Pseudomonas songnenensis</i>	<i>Streptomyces indoligenes</i>					<i>Dietzia papillomatosis</i>
	<i>Streptomyces alboflavus</i>						<i>Kocuria turfanensis</i>

2 May

*Acinetobacter
radioresistens*

Dietzia maris

*Nocardioides
solisilvae*

*Kocuria
dechangensis*

*Cellulosimicrobium
funkei*

*Streptomyces
neyagawaensis*

*Kocuria
himachalensis*

*Planococcus
rifietoensis*

*Pseudomonas
songnenensis*

*Rhodococcus
gordoniae*

*Williamsia
marianensis*

3 June

*Skermanella
aerolata*

Dietzia maris

Agrococcus baldri

Agrococcus baldri

*Rhodococcus
gordoniae*

*Cellulomonas
iranensis*

Agrococcus citreus

Agrococcus citreus

*Cellulomonas
iranensis*

*Microbacterium
paludicola*

*Cellulomonas
bogoriensis*

Nocardioides deserti

*Cellulomonas
hominis*

*Modestobacter
versicolor*

Skermanella rosea

*Cellulomonas
cellasea*

4 July	<i>Aeromicrobium erythreum</i>	<i>Microbacterium oryzae</i>	<i>Kocuria flava</i>	<i>Dietzia cinnamea</i>		<i>Cellulomonas iranensis</i>	<i>Williamsia marianensis</i>
	<i>Agrococcus citreus</i>	<i>Microbacterium paludicola</i>	<i>Ornithinimicrobium humiphilum</i>	<i>Micrococcus aloeverae</i>		<i>Kocuria dechangensis</i>	<i>Nocardioides zeae</i>
	<i>Cellulomonas flavigena</i>	<i>Pseudomonas balearica</i>	<i>Noviherbaspirillum agri</i>	<i>Modestobacter versicolor</i>		<i>Kocuria himachalensis</i>	
	<i>Exiguobacterium arabatum</i>	<i>Pseudomonas luteola</i>		<i>Pseudomonas songnenensis</i>		<i>Krasilnikoviella muralis</i>	
	<i>Kocuria flava</i>			<i>Rhodococcus gordoniae</i>		<i>Nocardioides flavus</i>	
5 August	<i>Blastococcus saxobsidens</i>		<i>Xylanimicrobium pachnodae</i>	<i>Cellulomonas iranensis</i>	<i>Xylanimicrobium pachnodae</i>	<i>Bacillus koreensis</i>	<i>Blastococcus aggregatus</i>
	<i>Pseudomonas balearica</i>		<i>Rhodocista pekingensis</i>	<i>Microbacterium oryzae</i>		<i>Kocuria flava</i>	<i>Kocuria polaris</i>
				<i>Nocardioides deserti</i>		<i>Micrococcus endophyticus</i>	<i>Nocardioides deserti</i>
				<i>Nocardioides solisilvae</i>		<i>Skermanella stibiïresistens</i>	<i>Rhodocista pekingensis</i>
						<i>Ornithinimicrobium humiphilum</i>	
6 September	<i>Kocuria flava</i>			<i>Microbacterium aureliae</i>	<i>Agrococcus baldri</i>	<i>Cellulomonas iranensis</i>	
	<i>Microbacterium lacusdiani</i>			<i>Microbacterium paludicola</i>	<i>Blastococcus aggregatus</i>	<i>Geodermatophilus taihuensis</i>	
	<i>Cellulomonas hominis</i>			<i>Nocardioides flavus</i>	<i>Blastococcus colisei</i>	<i>Kocuria polaris</i>	
	<i>Cellulomonas massiliensis</i>				<i>Kocuria turfanensis</i>	<i>Nocardioides sediminis</i>	

*Microbacterium
petrolearium*

*Planococcus
donghaensis*

*Planomicrobium
glaciei*

Table S2.

Sequencing of 16S rRNA-gene of hydrocarbonoclastic bacteria isolated from oil-saturated desert soil (OSS) and OSS diluted with pristine desert and garden soils.

Isolate designation	Total bases	Nearest Gene Bank match (accession no.)	Similarity %	Bases compared	Accession No.
HSC-3	498	<i>Streptomyces gulbargensis</i> (FN598542)	100	498/498	MK161114
HSC-4	532	<i>Pseudomonas songnenensis</i> (NR_148295)	100	532/532	MK161115
HSC-5	496	<i>Pseudomonas balearica</i> (NR_025972)	99	502/505	MK161116
HSC-20	533	<i>Agromyces iriomotensis</i> (NR_133690)	99	541/545	MK161117
HSC-23	491	<i>Bacillus circulans</i> (NR_118445)	99	497/500	MK161118
HSC-28	520	<i>Georgenia daeguensis</i> (NR_117960)	99	524/526	MK161119
HSC-30	477	<i>Acinetobacter radioresistens</i> (NR_114074)	99	483/486	MK161120
HSC-35	502	<i>Citricoccus yambaruensis</i> (NR_132666)	99	512/517	MK161121
HSC-45	516	<i>Skermanella aerolata</i> (NR_043929)	99	526/531	MK161122
HSC-48	517	<i>Exiguobacterium arabatum</i> (FM203124)	99	529/535	MK161123
HSC-56	510	<i>Xylanimicrobium pachnodae</i> (NR_024956)	99	522/528	MK161124
HSC-61	504	<i>Aeromicrobium erythreum</i> (NR_024846)	99	510/513	MK161125
HSC-75	515	<i>Blastococcus saxobsidens</i> (NR_117019)	99	517/518	MK161126
HSC-81	526	<i>Georgenia soli</i> (NR_116959)	99	530/532	MK161127
HSC-87	507	<i>Cellulomonas massiliensis</i> (NR_125601)	99	513/516	MK161128
HSC-506	516	<i>Streptomyces alboflavus</i> (NR_044151)	100	516/516	MK161129
HSC-511	518	<i>Micromonospora soli</i> (NR_146360)	99	520/521	MK161130
HSC-515	515	<i>Cellulomonas hominis</i> (NR_029288)	100	515/515	MK161131
DSA-89	509	<i>Streptomyces scopiformis</i> (NR_114403)	99	519/524	MK161132
DSA-98	513	<i>Pseudarthrobacter phenanthrenivorans</i> (NR_074770)	99	519/522	MK161133
DSA-100	513	<i>Nocardioides solisilvae</i> (NR_136850)	99	515/516	MK161134
DSA-102	501	<i>Nocardioides deserti</i> (KY436429)	99	503/504	MK161135
DSA-104	509	<i>Gordonia hankookensis</i> (NR_104507)	99	513/515	MK161136
DSA-105	477	<i>Streptomyces youssoufiensis</i> (NR_116980)	98	495/505	MK161137
DSA-111	414	<i>Nocardioides aquiterrae</i> (NR_025261)	99	416/417	MK161138
DSA-114	509	<i>Arthrobacter subterraneus</i> (KY436432)	99	513/515	MK161139
DSA-118	504	<i>Aeromicrobium massiliense</i> (NR_125588)	99	510/513	MK161140
DSA-124	504	<i>Gordonia amicalis</i> (NR_028735)	99	516/522	MK161141
DSA-134	525	<i>Pseudomonas luteola</i> (NR_114215)	99	539/546	MK161142
DSA-146	517	<i>Kocuria flava</i> (NR_044308)	100	517/517	MK161143
DSA-155	499	<i>Cellulomonas iranensis</i> (NR_024914)	99	503/505	MK161144
DSA-162	495	<i>Micrococcus flavus</i> (NR_043881)	99	497/498	MK161145
DSA-516	507	<i>Streptomyces indoligenes</i> (NR_149274)	99	515/519	MK161146
DSA-517	514	<i>Pseudonocardia halophobica</i> (NR_116193)	99	520/523	MK161147
DSB-163	506	<i>Streptomyces alfalfae</i> (NR_147713)	99	510/512	MK161148
DSB-165	503	<i>Kocuria dechangensis</i> (NR_137239)	99	511/515	MK161149
DSB-166	501	<i>Blastococcus aggregatus</i> (NR_114864)	100	501/501	MK161150
DSB-169	501	<i>Arthrobacter tumbae</i> (NR_042078)	100	501/501	MK161151

DSB-170	494	<i>Streptomyces griseoflavus</i> (KU720585)	100	494/494	MK161152
DSB-173	495	<i>Arthrobacter echini</i> (NR_148833)	99	503/507	MK161153
DSB-181	484	<i>Williamsia marianensis</i> (NR_118613)	99	486/487	MK161154
DSB-182	496	<i>Kocuria himachalensis</i> (LC113906)	99	499/501	MK161155
DSB-183	474	<i>Planococcus rifietoensis</i> (MF417406)	98	491/500	MK161156
DSB-192	502	<i>Dietzia maris</i> (NR_118596)	100	502/502	MK161157
DSB-196	515	<i>Kocuria polaris</i> (KX959605)	100	515/515	MK161158
DSB-197	504	<i>Roseomonas oryzae</i> (NR_137403)	99	506/507	MK161159
DSB-202	512	<i>Dietzia papillomatosis</i> (NR_116687)	100	512/512	MK161160
DSB-209	444	<i>Azospirillum rugosum</i> (NR_042582)	99	450/453	MK161161
DSB-525	511	<i>Actinotalea ferrariae</i> (NR_118034)	99	517/520	MK161162
DSB-529	516	<i>Streptomyces maoxianensis</i> (NR_148303)	99	518/519	MK161163
DSB-533	489	<i>Noviherbaspirillum agri</i> (KX129821)	97	521/537	MK161164
DSC-229	520	<i>Arthrobacter phenanthrenivorans</i> (NR_042469)	99	524/526	MK161165
DSC-235	430	<i>Pseudomonas knackmussii</i> (NR_117756)	99	436/439	MK161166
DSC-236	495	<i>Microbacterium aerolatum</i> (NR_028944)	99	499/501	MK161167
DSC-238	525	<i>Georgenia satyanarayanai</i> (NR_117051)	99	527/528	MK161168
DSC-243	493	<i>Dietzia cinnamea</i> (NR_116686)	100	493/493	MK161169
DSC-244	521	<i>Cellulosimicrobium funkei</i> (NR_042937)	99	527/530	MK161170
DSC-249	525	<i>Arthrobacter ginsengisoli</i> (KF212463)	99	527/528	MK161171
DSC-254	530	<i>Agrococcus citreus</i> (NR_041542)	99	534/536	MK161172
DSC-261	525	<i>Micrococcus endophyticus</i> (KY933306)	99	527/528	MK161173
DSC-267	529	<i>Micrococcus aloeverae</i> (NR_134088)	99	531/532	MK161174
DSC-268	518	<i>Modestobacter versicolor</i> (NR_042368)	100	518/518	MK161175
DSC-279	523	<i>Krasilnikoviella muralis</i> (LC148843)	99	531/535	MK161176
DSC-284	524	<i>Microbacterium oryzae</i> (NR_117527)	99	530/533	MK161177
DSC-290	520	<i>Microbacterium aureliae</i> (NR_152652)	99	524/526	MK161178
DSC-543	513	<i>Alkanindiges hongkongensis</i> (NR_115179))	99	525/531	MK161179
DSC-544	509	<i>Cellulomonas cellasea</i> (NR_037077)	99	511/512	MK161180
DSC-556	496	<i>Nocardioides flavus</i> (AF005014)	98	514/523	MK161181
GSA-299	511	<i>Micrococcus cohnii</i> (NR_117194)	99	519/523	MK161182
GSA-300	521	<i>Streptomyces yangpuensis</i> (NR_148776)	99	523/524	MK161183
GSA-304	493	<i>Arthrobacter agilis</i> (NR_026198)	99	515/526	MK161184
GSA-309	427	<i>Cellulomonas flavigena</i> (NR_074490)	98	443/451	MK161185
GSA-316	523	<i>Microbacterium lacusdiani</i> (KP986565)	99	529/523	MK161186
GSA-328	526	<i>Agrococcus baldri</i> (NR_041543)	99	532/535	MK161187
GSA-329	400	<i>Cellulomonas bogoriensis</i> (NR_114941)	99	412/418	MK161188
GSA-337	507	<i>Skermanella rosea</i> (NR_152076)	100	507/507	MK161189
GSA-356	508	<i>Rothia endophytica</i> (NR_109752)	99	516/520	MK161190
GSA-362	516	<i>Planomicrobium glaciei</i> (NR_044384)	99	520/522	MK161191
GSA-366	507	<i>Microbacterium petrolearium</i> (NR_134087)	99	513/516	MK161192
GSA-368	509	<i>Georgenia sediminis</i> (NR_109690)	98	529/539	MK161193
GSA-369	411	<i>Xylanimonas cellulositytica</i> (NR_074544)	99	421/426	MK161194
GSA-370	520	<i>Planococcus donghaensis</i> (NR_044073)	99	524/526	MK161195
GSA-372	443	<i>Blastococcus colisei</i> (NR_149176)	99	455/461	MK161196

GSB-381	508	<i>Stenotrophomonas rhizophila</i> (NR_121739)	97	536/550	MK161197
GSB-382	525	<i>Lentzea chajnantorensis</i> (NR_149214)	99	527/528	MK161198
GSB-383	514	<i>Rhodococcus erythropolis</i> (KJ476725)	99	520/523	MK161199
GSB-395	523	<i>Streptomyces neyagawaensis</i> (NR_025868)	66	525/526	MK161200
GSB-409	530	<i>Kocuria turfanensis</i> (NR_043899)	99	534/536	MK161201
GSB-422	450	<i>Skermanella stibiirensis</i> (NR_117972)	96	486/504	MK161202
GSB-424	542	<i>Bacillus persicus</i> (KY436466)	99	546/548	MK161203
GSB-425	523	<i>Microbacterium paludicola</i> (NR_114939)	99	525/526	MK161204
GSB-431	499	<i>Geodermatophilus taihuensis</i> (NR_109679)	98	523/535	MK161205
GSB-433	514	<i>Nocardioides sediminis</i> (NR_044228)	99	530/538	MK161206
GSB-588	510	<i>Cellulosimicrobium marinum</i> (NR_146662)	99	512/513	MK161207
GSB-590	511	<i>Pseudonocardia kongjuensis</i> (NR_025384)	100	511/511	MK161208
GSC-439	515	<i>Nocardia fluminea</i> (NR_117325)	100	515/515	MK161209
GSC-441	522	<i>Arthrobacter bambusae</i> (NR_133968)	99	426/528	MK161210
GSC-443	525	<i>Streptomyces fulvissimus</i> (KY820858)	99	527/528	MK161211
GSC-444	501	<i>Aeromicrobium ginsengisoli</i> (NR_041384)	98	517/525	MK161212
GSC-464	392	<i>Arthrobacter aurescens</i> (KJ476726)	99	394/395	MK161213
GSC-468	508	<i>Rhodococcus gordoniae</i> (AB915625)	99	518/523	MK161214
GSC-469	458	<i>Microbacterium ginsengiterrae</i> (NR_116483)	99	460/461	MK161215
GSC-490	480	<i>Rhodocista pekingensis</i> strain 3-p (NR_028855)	98	500/510	MK161216
GSC-492	506	<i>Nocardioides albus</i> (KY436468)	99	514/518	MK161217
GSC-500	547	<i>Moraxella osloensis</i> (KT989843)	100	547/547	MK161218
GSC-603	515	<i>Ornithinimicrobium humiphilum</i> (KT989854)	99	525/530	MK161219
GSC-606	489	<i>Nocardioides zeae</i> (NR_134102)	98	509/519	MK161220



Fig. S1 Suitability of oil-saturated soil for cropping of broad beans..

A, Unbioremediated; B, 6-months bioremediated soil.