Supplementary Information.

Table S1. Mineral media composition per litre.

Reagent	Chemical Formula	Concentration (g/L)
Potassium dihydrogen phosphate	KH_2PO_4	0.27
Disodium hydrogen phosphate dodecahydrate	$Na_2HPO_4 \cdot 12H_2O$	1.12
Ammonium chloride	NH_4Cl	0.53
Calcium chloride dihydrate	$CaCl_2 \cdot 2H_2O$	0.075
Magnesium chloride hexahydrate	$MgCl_2 \cdot 6H_2O$	0.10
Iron(II) chloride tetrahydrate	$FeCl_2 \cdot 4H_2O$	0.02
Resazurin (oxygen indicator)		0.001
Disodium sulfide	$Na_2S \cdot 9H_2O$	0.1
Stock solution of trace elements (Table 2)		10 ml

Table S2. Trace element solution composition per litre.

Reagent	Chemical Formula	Concentration (g/L)
Manganese chloride tetrahydrate	$MnCl_2 \cdot 4H_2O$	0.05
Boric acid	H_3BO_3	0.005
Zinc chloride	$ZnCl_2$	0.005
Copper chloride	$CuCl_2$	0.003
Disodium molybdate dihydrate	$Na_2MoO_4 \cdot 2H_2O$	0.001
Cobalt chloride hexahydrate	$CoCl_2 \cdot 6H_2O$	0.1
Nickel chloride hexahydrate	$NiCl_2 \cdot 6H_2O$	0.01
Disodium selenite	Na_2SeO_3	0.005
Disodium tungstate	$Na_2WO_4 \cdot 2H_2O$	0.002

Table S3. Site locations and descriptions.

Site	Short name	Type	Location
Harpur Hill, Buxton	B	Lime	52.2351, -1.91714
Horton Quarry, Horton	H	Lime	54.14658, -2.30414
Tarmac, Grassington	T	Lime	54.05422, -2.03002
Ancient lime kiln 1	LK1	Lime	54.07802, -2.06583
Ancient lime kiln 2	LK2	Lime	54.07775, -2.06705
Ancient lime kiln 3	LK3	Lime	54.07802, -2.07179
Ancient lime kiln 4	LK4	Lime	54.07999, -2.07883
Ancient lime kiln 5	LK5	Lime	54.07855, -2.0776
Consett Stream, Consett	CS	Steel	54.85391, -1.862
Consett Wetland, Consett	CW	Steel	54.83725, -1.85649
Redcar	RC	Steel	54.61253, -1.08952
Tata, Scunthorpe	SC	Steel	53.57808, -0.59291

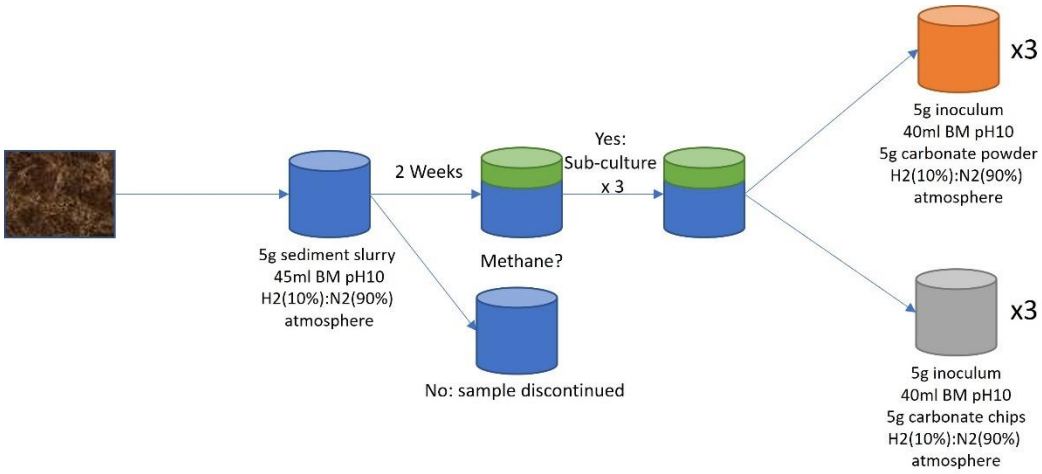

Figure S1. Overall scheme of microcosm development. In control experiments, 5ml of BM was added in place of 5g of inoculum.

Table S4. Mean production of methane by soil and leachate type over 42 day incubation.

		Methane produced (mmol)	
		Carbon source	
Soil origin	**Leachate origin**	**Powder**	**Chips**
B	Lime	0.22	0.13
H	Lime	0.37	0.20
T	Lime	0.18	0.17
LK1	Lime	0.38	0.18
LK2	Lime	0.23	0.12
LK3	Lime	0.38	0.23
LK4	Lime	0.27	0.25
LK5	Lime	0.45	0.16
CW	Steel slag	0.49	0.48
CS	Steel slag	0.47	0.47
RC	Steel slag	0.48	0.49
SC	Steel slag	0.45	0.48
-	Uninoculated control	0.00	0.00

Table S5. Stoichiometric calculations of methane production and hydrogen consumption assuming the reduction of carbon dioxide to methane as $CO_2 + 4\ H_2 \rightarrow CH_4 + 2\ H_2O$.

		mmoles		
Soil origin	**Carbonate type**	**Hydrogen Consumed**	**Methane produced (actual)**	**Methane produced (theoretical)**
Lime	Powder	2.60	0.31	0.65
Steel	Powder	3.26	0.47	0.82
Lime	Marble chips	1.76	0.18	0.44
Steel	Marble chips	2.73	0.48	0.68

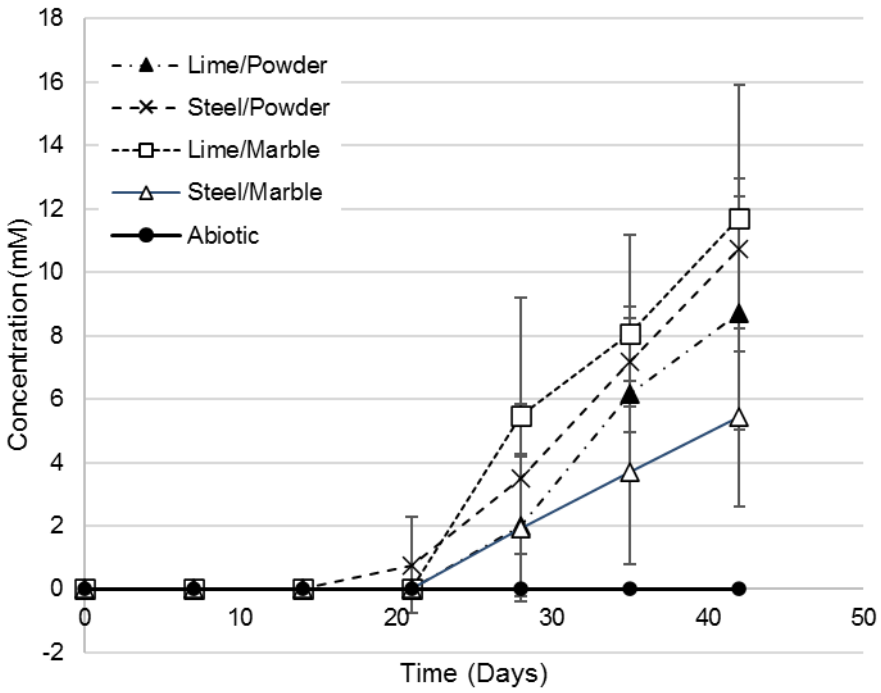

Figure S2. The production of acetic acid was observed in microcosms irrespective of lime/steel enrichment or carbonate supplement source.

Table S6. Number of OTUs observed within each microcosm Archaeal community.

Enrichment Type	Site	Number of OTUs Supplement	
		Powder	Marble
Lime	B	31	47
	H	100	210
	T	108	453
	LK1	58	450
	LK2	161	211
	LK3	87	286
	LK4	84	236
	LK5	50	200
Steel	CS	53	25
	CW	37	33
	RC	37	42
	SC	24	16

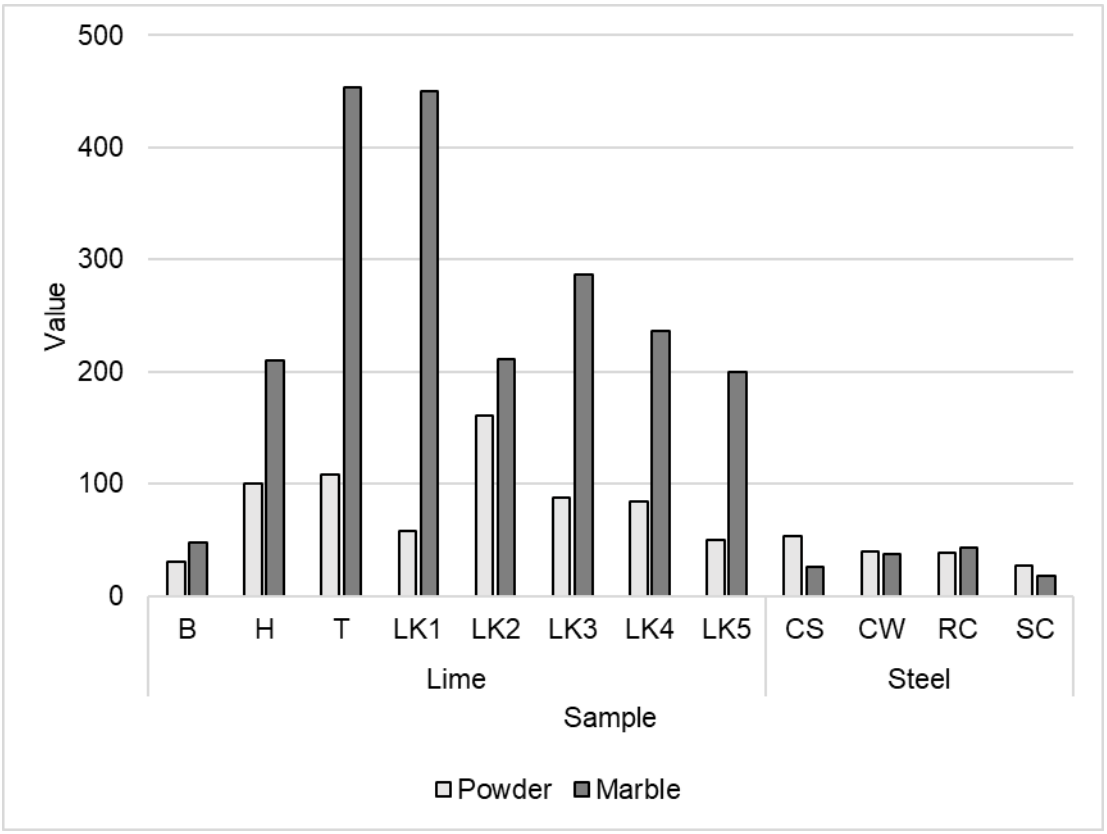

Figure S3. Chao1 values for the Archaeal communities present within the lime/steel and calcium carbonate powder/marble chip microcosms.