

Table 1: Main features of the extremophilic viruses so far characterized in extreme environments

Environment, Source (viral abundance) Family, Species	Virion morphology, Size (nm) (head: tail) or (length x diameter)	Host (kingdom, genus, species)	Temperate/ lytic/ carrier state	dsDNA form, Genome size (kb) <sup>a</sup>	Homologous genes with	Genes with unassigned function (%)	Sequence acc. nr	References	
Hypersaline environments									
Dead Sea (10 <sup>7</sup> ml <sup>-1</sup> ), Solar salterns (10 <sup>9</sup> ml <sup>-1</sup> )				10-533				Oren et al. (1997), Guixa-Boixareu et al. (1996)	
<i>Myoviridae</i>									
φH	Isometric head and contractile tail (64:170)	Archaea: <i>Halobacterium salinarum</i>	Temperate	Linear	59	φCh1	nd	genome fragments <sup>b</sup>	Gropp et al. (1989), Schnabel et al. (1982), Stolt et al. (1992, 1993, 1994)
φCh1	Isometric head and contractile tail (70:130)	Archaea: <i>Natrialba magadii</i>	Temperate	Linear	58.5	φH, ψM2	78.5	AF440695	Klein et al. (2002), Witte et al. (1997)
HF1	Isometric head and contractile tail (58:94)	Archaea: <i>Haloferax volcanii</i> , <i>Haloarcula Halobacterium salinarium</i>	Lytic	Linear	77.7	HF2, phage RB29, phage T4, phage φCTX	88	AY190604	Nuttall and Dyall-Smith (1993), Tang et al. (2004)
HF2	Isometric head and contractile tail (58:94)	Archaea: <i>Halobacterium saccharovorum</i>	Lytic	Linear	75.9	HF1, phage RB29, mycophage L5, mycobacteriophage D29 phage T4,	87	AF222060	Nuttall and Dyall-Smith (1993, 1995), Tang et al. (2002)
Salterprovirus <sup>c</sup>									
His1	Spindle-shaped (77x44)	Archaea: <i>Haloarcula</i> , <i>Haloferax</i> , <i>Halobacterium</i>	Lytic	Linear	14.4	His2, SH1, phage PR772	94	AF191796	Bath and Dyall-Smith (1998)
His2	Spindle-shaped (67 x 44)	Archaea: <i>Haloarcula hispanica</i>	Lytic	Linear	16.1	His1, phage GIL16c	91	AF191797	Bath et al. (2006)
Unclassified SH1	Isometric (55)	Archaea: <i>Haloarcula hispanica</i> , <i>Halorubrum sodomense</i>	Lytic	Linear	30.9	φCh1, His1	78.5	NC007217	Bamford et al. (2005), Porter et al. (2005)
Alkaline lakes (10 <sup>8</sup> -10 <sup>9</sup> ml <sup>-1</sup> )				14-400				Jiang et al. (2004)	
Unclassified φMono1	nd	nd	Bacteria: <i>Idiomarina baltic<sup>c</sup></i>	Lytic	nd	nd	nd	nd	Maranger et al. (1994), Borriss et al. (2003)
Polar environments									
Arctic sea ice (9.10 <sup>6</sup> ml <sup>-1</sup> – 3.10 <sup>8</sup> ml <sup>-1</sup> )								Borriss et al. (2003)	
<i>Myoviridae</i>									
Isolate 1a	Isometric head and contractile tail (65-73: 93-103)	Bacteria: <i>Shewanella<sup>c</sup></i>	Lytic	nd	70	nd	nd	nd	Borriss et al. (2003)
<i>Siphoviridae</i>									
Isolate 11b	Isometric head and non contractile tail (37-43: 75-91)	Bacteria: <i>Flavobacterium<sup>c</sup></i>	Lytic	nd	30	nd	nd	nd	Borriss et al. (2003)
Isolate 21C	Isometric head and non contractile tail (45-48: 150-188)	Bacteria: <i>Colwellia<sup>c</sup></i>	Lytic	nd	40-50	nd	nd	nd	Borriss et al. (2003)
Antarctic sea ice (5.2.10 <sup>6</sup> ml <sup>-1</sup> – 3.5.10 <sup>8</sup> ml <sup>-1</sup> )								Gowing (2003)	
Unclassified	Icosahedral, spherical and lumpy forms	Microeucaryotes?	nd	nd	30-70	nd	nd	nd	Gowing (2003)
Antarctic lakes (3.4.10 <sup>7</sup> ml <sup>-1</sup> )								Kepner et al. (1998)	
Unclassified	Large isometric form	Flagellates?	nd	nd	nd	nd	nd	nd	Kepner et al. (1998)
Desert environments									
Sahara Desert (nd)									
<i>Myoviridae</i>	Isometric head and contractile tail (82-185: 129-385)	nd	Temperate?	nd	270	nd	nd	nd	Prigent et al. (2005)
<i>Siphoviridae</i>	Hexagonal head and non contractile tail (80-110 x 40 :0-15)	nd	Temperate?	nd	45-80	nd	nd	nd	Prigent et al. (2005)
<i>Podoviridae</i>	Isometric head and non contractile tail (50-90 :155-460)	nd	Temperate?	nd	45-80	nd	nd	nd	Prigent et al. (2005)
Deep subsurface biosphere									
Deep subsurface sediments (10 <sup>9</sup> g <sup>-1</sup> )	nd	nd	nd	nd	nd	nd	nd	nd	Bird et al. (2001)

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Extreme thermal environments								
Terrestrial hot springs (10 <sup>6</sup> ml <sup>-1</sup> )								
<i>Fuselloviridae</i>								
SSV1	Spindle-shaped (100 x 60)	Archaea: <i>Sulfolobus</i>	Temperate	ccc <sup>f</sup> 15,5	SSV2, SS-K1, SSVRH, SIRV1, SIRV2, ARV1	88	XO7234	Breitbart et al. (2004)
SSV2	Spindle-shaped (80 x 55)	Archaea: <i>Sulfolobus</i>	Temperate	ccc 14,8	SSV2, SS-K1, SSVRH	88	AY370762	Martin et al. (1984), Palm et al. (1991), Schleper et al. (1992)
SS-K1	Spindle-shaped (90 x 60)	Archaea: <i>Sulfolobus</i>	Temperate	ccc 17,4	SSV1, SSV2, SSVRH	92	AY423772	Stedman et al. (2003)
SSVRH	Spindle-shaped (90 x 60)	Archaea: <i>Sulfolobus</i>	Temperate	ccc 16,5	SSV1, SSV2, SS-K1	90	AY388628	Wiedenheft et al. (2004)
<i>Lipothrixviridae</i>								
TTV1	Non-flexible rod (410 x 38)	Archaea: <i>Thermoproteus tenax</i>	Temperate	Linear 15.9	none	84	X14855	Janekovic et al. (1983)
TTV2	Flexible rod (1200 x 20)	Archaea: <i>T. tenax</i>	Temperate	nd 16	nd	nd	nd	Janekovic et al. (1983)
TTV3	Flexible rod (2500 x 30)	Archaea: <i>T. tenax</i>	nd	nd 27	nd	nd	nd	Janekovic et al. (1983)
SIFV	Flexible rod (2000 x 24)	Archaea: <i>Sulfolobus islandicus</i>	Carrier state	Linear 40.9	DAFV, SSV1, SIRV1, SIRV2, ARV1, AFV1, AFV2	95	AF440571	Arnold et al. (2000b)
AFV1	Flexible rod (900 x 24)	Archaea: <i>Acidianus</i>	Carrier state	Linear 21.1	SIFV, SIRV1, SIRV2, SSV1, AFV2	88	AJ567472	Bettstetter et al. (2003)
AFV2	Flexible rod (1100 x 24)	Archaea: <i>Acidianus</i>	Carrier state	Linear 31.8	SIFV, AFV1, SIRV1, SIRV2	94	AJ854042	Håring et al. (2005b)
<i>Rudiviridae</i>								
SIRV1	Stiff rod (930 x 22)	Archaea: <i>Sulfolobus islandicus</i>	Temperate	Linear 32.3	SIFV, SIRV2, ARV1, AFV1, AFV2, SSV1, poxviruses, ASFV, Chlorella viruses	89	AJ414696	Prangishvili et al. (1999)
SIRV2	Stiff rod (900 x 23)	Archaea: <i>Sulfolobus islandicus</i>	Carrier state	Linear 35.5	SIRV1, SIFV, SSV1, AFV1, AFV2, poxviruses, ASFV, Chlorella viruses	91	AJ344259	Prangishvili et al. (1999)
ARV1	Stiff rod (610 x 22)	Archaea: <i>Acidianus</i>	Carrier state	Linear 24.7	SIFV, SIRV1, SIRV2, AFV1, SSV1	83	AJ875026	Vestergaard et al. (2005)
<i>Guttaviridae</i>								
SNDV	Droplet-shaped (100-185 x 70-95)	Archaea: <i>Sulfolobus neozelandicus</i>	Carrier state	nd	nd	nd	nd	Arnold et al. (2000a)
<i>'Globuloviridae'</i>								
PSV	Spherical (100)	Archaea: <i>Pyrobaculum, Thermoproteus</i>	Carrier state	Linear 28.3	none	100	AJ635162	Håring et al. (2004)
TTSV1	Spherical nd	Archaea: <i>T. tenax</i>	nd	Linear 20.9	PSV VP2	100	AY722806	Ahn et al. (2004)
<i>'Ampullaviridae'</i>								
ABV	Bottle-shaped (230 x 75-4)	Archaea: <i>Acidianus convivator</i>	Carrier state	Linear 23.9	nd	nd	nd	Håring et al. (2005)
<i>'Bicaudaviridae'</i>								
ATV	Spindle-shaped (110-180 x 70-100) with two tails (total length ~ 1000)	Archaea: <i>Acidianus convivator</i>	Temperate	ccc 62.7	SSV1, ARV1, SIFV, STSV1	90	AJ888457	Håring et al. (2005c)
Unclassified								
STIV	Isometric (60)	Archaea: <i>Sulfolobus</i>	nd	ccc 17.7	none	97	AY569307	Rice et al. (2004)
STSV1	Spindle-shaped (230 x 107)	Archaea: <i>Sulfolobus</i>	Carrier state	ccc 75.3	ATV, SSV1, SSV2, SS-K1, SSVRH	81	AJ783769	Xiang et al. (2005)
Deep sea hydrothermal vents (1.45.10 <sup>5</sup> – 9.9.10 <sup>7</sup> ml <sup>-1</sup> )								
Unclassified								
PAV1	Spindle-shaped (120 x 80)	Archaea: <i>Pyrococcus abyssi</i>	Carrier state	ccc 18.1	none	96	nd	Ortmann and Suttle (2005)
Geslin et al. (2003a, b)								

nd: not determined

<sup>a</sup> Approximate values

<sup>b</sup> (X80163, X80162, X80161, X00805, X52504, AH004327, S63994, 405325, S63993, 405323, S63992

<sup>c</sup> Isolate related to

<sup>d</sup> Flotting genus

<sup>e</sup> Taxonomic proposals

<sup>f</sup> Covalently closed, circular