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Visualising Geomorphology:

Improving Communication Of Data and Concepts Through Engagement With the Arts

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Previous ESEX commentaries have raised concerns over the limited, possibly even decreasing, visibility of geomorphology as a discipline and a term (e.g. Tooth, 2009; Gregory et al., 2014; Woodward, 2015). Proposed solutions have focused on ways to improve communication of geomorphology, but have tended to emphasise traditional forms of academic dissemination, including meetings (Gregory et al., 2014) and textbooks (Woodward, 2015). The contention of this commentary is that greater engagement with the arts can provide alternative communication channels for our data and concepts, and thereby help to

1
2 26 raise the visibility of geomorphology, both literally and metaphorically.
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7 28 **Context**

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9 29 Recent years have seen increased collaboration between the arts and sciences, with
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11 30 conferences, exhibitions and residencies devoted to exploring the inspirations and mutual
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13 31 benefits that can arise from activities that bridge the two spheres. Critical commentaries have
14
15 32 focused on the tensions between art's roles in illustrating, communicating, and interrogating
16
17 33 sciences such as biology, chemistry, physics, climate change and geology (e.g. Kemp, 2000;
18
19 34 Ede, 2005; Wilson, 2010; Miller, 2014; Gorman, 2014). But where is geomorphology? The
20
21 35 discipline has a rich visual subject matter that has long offered aesthetic inspiration for artists
22
23 36 (e.g. painters, photographers, sculptors, poets, film makers, musicians), and there are
24
25 37 historical examples where geomorphologists have engaged with the arts to help communicate
26
27 38 data and concepts, including by embedding artists in scientific expeditions (Rees, 1973).
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29 39 Presently, however, geomorphology-art collaborations remain limited in number and scope,
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31 40 and so the potential intellectual benefits and opportunities for promoting geomorphology as an
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33 41 active, relevant science remain underexploited.
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42 43 To address this issue, the British Society for Geomorphology's 'Visualising Geomorphology'
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44 44 Working Group has been established. The Group's remit is to explore the possibilities for
45
46 45 engagement with the arts (broadly defined to include diverse visual and non-visual forms of
47
48 46 creative expression) to help raise the visibility of the Society and the discipline more
49
50 47 generally. To prompt discussion, the following sections address interrelated issues that
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52 48 include historical, contemporary and forward-looking aspects of geomorphology-art relations.
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51 **Geomorphology as artistic inspiration**

52 Earth surface processes and landforms provide a kaleidoscope of perspectives, colours,
53 textures, smells and sounds that can provoke aesthetic inspiration across the visual and non-
54 visual arts. Resulting art works may be displayed (paintings, photographs), projected (films),
55 performed (poetry, music) or installed (sculptures). Land art works, such as by Richard Long
56 or Robert Smithson (Figure 1), are made directly in the landscape by sculpting earth or
57 building structures using natural materials including boulders and organic debris (Tufnell,
58 2006). Yet despite geomorphological subject matter serving as inspiration, with the resulting
59 art works helping to shape perceptions of landscape, these examples only serve to highlight
60 that the geomorphological community has been slow to seize the opportunities for promoting
61 the discipline. Does a landscape painting, photograph, poem or land art work – valuable
62 though they may be in cultural terms – lead to enhanced awareness of the geomorphological
63 discipline, or to greater appreciation of geomorphologists' roles in society? In most cases, the
64 answer is likely 'no'. Many landscape-inspired artists share conceptual concerns with
65 geomorphologists – for instance, in conveying the nature of time and history, process and
66 material flux, and human influence – but their activities commonly remain largely divorced
67 from geomorphological science. Even where artists have a background in geomorphology
68 (e.g. photographer James Balog) and the subject matter is explicitly geomorphological (e.g.
69 rapid changes to glacial landscapes), the discipline is rarely mentioned, or the subject matter
70 is commonly badged with alternative (supra)disciplinary labels (e.g. 'geology', 'geoscience').
71 Where benefits have accrued to geomorphology from artistic works, these are usually
72 incidental and after-the-fact; for example, some geomorphologists have mined historical
73 paintings, poems or other documents to reconstruct past environments, including flood and
74 tsumani events, glacial and fluvial landscape dynamics, and changing societal perceptions of
75 landscape (e.g. Zumbühl et al., 2008; Goff, 2012; Griffiths and Salisbury, 2013).

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2 763
4 77 Figure 1 here5
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9 79 **The artistic aspects of geomorphology**10
11 80 Artistic decisions are involved when representing complex three-dimensional landforms on a
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14 81 flat page, particularly when attempting to incorporate a sense of temporal change.15
16 82 Traditionally, visualisation in geomorphology has revolved around sketches, plan view maps,
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19 83 cross sections, use of block diagrams ('cartoons'), graphs, and photographs. As with all
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21 84 aspects of science imaging (Frankel, 2004), decisions need to be made regarding features to
22
23 85 include and ignore, perspective, scale, symbology, colour schemes and/or shading. These
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25
26 86 decisions are partly scientific and partly artistic, as shown by a particularly rich tradition in
27
28 87 cartography and landscape change illustrations (Figures 2A-B), some of which arguably form
29
30 88 artworks in themselves, while others have inspired artists (Crozier and Priestley, 2011).31
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33 89
34
35 90 Figure 2 here36
37 9138
39
40 92 In an increasingly technology-driven, digital world, which visualisation techniques remain most
41
42 93 useful for communicating geomorphology? Field sketches – a prominent feature of D. Dixon
43
44 94 et al.'s (2013) commentary on the aesthetic aspects of geomorphology – have long fallen out
45
46
47 95 of fashion and nowadays are rarely undertaken as part of research projects, let alone
48
49 96 incorporated in publications, but might still have value in outreach (see below). But can the
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51
52 97 artistic decisions embedded in these traditional geomorphological visualisations be
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54 98 augmented by newer techniques that incorporate automated data capture, digital processing,
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56 99 and graphic design? Cartography and mapping, for instance, have derived major benefits
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58
59 100 from technological developments (e.g. high-resolution imaging tools such as LiDAR) with
60

1
2 101 some outputs again forming artworks in themselves (Figure 2C). Landform and landscape
3
4 102 photography has also benefitted greatly from technological developments (e.g. remotely
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6
7 103 sensed imagery, time lapse techniques, Structure-from-Motion photogrammetry, digital
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9 104 enhancement). Visualisation of dynamic earth surface processes and microforms is more
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11
12 105 challenging, but benefits have arisen from technological developments (e.g. high-
13
14 106 magnification SEM imaging or high-speed photography), and the resulting images also may
15
16 107 have aesthetic appeal (Figure 2D).
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19 108
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21 109 In other scientific disciplines, the merger of new technologies and visualisation techniques
22
23 110 sometimes has gone beyond mere communication, and even helped to alter the direction of
24
25
26 111 scientific research. Cressey (2014) cites historical examples where visual representations of
27
28 112 medical data helped changed the way science was conducted. During the early phase of
29
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31 113 space exploration, a photograph showing our planet rising above the Moon's horizon
32
33 114 ('Earthrise') contributed to the growth of environmentalism and the now-familiar scientific
34
35 115 conception of the Earth as a system. Today, new technologies are opening up new physical
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37
38 116 frontiers (e.g. the deep oceans, other planetary landscapes), so could novel visualisations of
39
40 117 captured data result in similarly transformative images for geomorphology?
41

42 118 43 44 45 119 **New artistic approaches to communicate geomorphology to non-specialists**

46
47 120 Engagement with artistic approaches undoubtedly can help communicate geomorphology
48
49 121 among specialist academic audiences, but significant impacts can also be made in outreach
50
51
52 122 contexts. Commenting on his 25-year tracking of a spherical chunk of oak down the Afon
53
54 123 Dwyrdd, north Wales, sculptor David Nash noted that this serendipitous piece of art "became
55
56
57 124 a stepping-stone into the drama of physical geography" (Peterson, 2008). Along with land art
58
59 125 works that ultimately become part of the topography (Figure 1), such 'experiments' could be
60

1
2 126 more widely exploited for geomorphology's benefit, particularly by helping to communicate
3
4 127 key concepts such as time, process, and material flux to non-specialist audiences. Could
5
6
7 128 newer, technology-driven artistic approaches also be employed to communicate
8
9 129 geomorphology to these audiences? Geomorphological subject matter has yet to feature
10
11
12 130 widely among a recent surge in digital artworks but many possibilities exist, including using: i)
13
14 131 video animations to visualise landscape change scenarios (e.g. with sea level rise); ii) laser
15
16 132 scanning and 3D printing, or other novel sculptural approaches, to reveal 'invisible' landform
17
18
19 133 details (e.g. abraded river pothole interiors, subterranean insect colony structures); and iii)
20
21 134 naturally-derived 'soundworks' to enhance perception of geomorphological processes (e.g.
22
23 135 the sonics of bedload transport or aeolian saltation). Multisensorial approaches that enable
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25
26 136 immersion inside virtual realities (e.g. using The Oculus Rift system) also offer many
27
28 137 possibilities for communicating geomorphology (see SeriousGeoGames website).

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30 138
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33 139 Practical applications include improved communication of geomorphology at popular natural
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35 140 attractions. Accurate and engaging geomorphological information for landforms and
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37
38 141 landscapes is commonly non-existent or poorly presented, even in national parks. But the
39
40 142 above artistic approaches – perhaps disseminated using podcasts or apps – could help
41
42 143 enliven and/or enhance the design and display of geomorphological information traditionally
43
44
45 144 presented on signboards or dioramas, including to people with impairments. For example,
46
47 145 greater use of non-visual (auditory or tactile) artistic approaches for illustration of processes
48
49 146 and landforms could help to communicate geomorphology to those deprived of visual
50
51
52 147 faculties. Haptic use of 3D printing has great potential here, and the power of the written
53
54 148 word in describing landscape change using non-technical language is also important (e.g.
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56 149 Norman Nicholson's poem 'Beck' - Whalley, 2014).

1
2 151 Irrespective of social or educational background, the 'beauty' or 'experience' of landscape is
3
4 152 something that appeals to many people (Goudie and Viles, 2010) but could improved
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6
7 153 geomorphological communication through engagement with the arts further help to heighten
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9 154 landscape appreciation? This is a vexed issue but requires consideration, especially for
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11
12 155 geoconservation and geoh heritage promotion. Case studies show how geomorphology is
13
14 156 integral to many aspects of culture (Gregory, 2006) and abundant opportunities exist to
15
16 157 interweave geomorphology with art and other knowledge forms in novel, engaging ways to
17
18
19 158 heighten landscape appreciation. Alongside the technology-driven approaches highlighted
20
21 159 above, and linked with revitalised debate over the role and value of fieldwork in
22
23 160 geomorphological research and education (Legleiter and Marston, 2013; Thornbush et al.,
24
25
26 161 2014), field locations can enable experimentation with alternative means of communicating
27
28 162 geomorphology to non-specialists in accessible and affective ways. Field-based participatory
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30
31 163 art projects that are concerned with collective interactions in the process of creating an art
32
33 164 work or event (e.g. a landscape 'walkover') offer particular opportunities. As part of these
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35 165 projects, landform sketching or poetic expression might help people to capture the personal
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38 166 essence of their landscape experience, while also providing opportunities to communicate
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40 167 geomorphology.

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44 45 169 **Possible ways forward?**

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47 170 Other scientific disciplines (e.g. biology, geology) have been proactively and successfully
48
49 171 engaging with the arts to help communicate data and concepts, thereby raising their profiles.
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51
52 172 Geomorphology has been slow off the mark, so we end with some linked challenges: i) can
53
54 173 we identify the types of geomorphological data and concepts that are best suited for visual
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56
57 174 and non-visual artistic expressions?; ii) how can we encourage more geomorphologists
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59 175 working with these types of data and concepts to consider engaging with the arts to
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1
2 176 communicate their research?; and iii) how can geomorphologists best cultivate mutually-
3
4 177 beneficial collaborations with individuals from the arts communities?
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9 179 Currently, some of the most fertile ground for engaging with the arts is provided by debates
10
11
12 180 over future climate change and the putative Anthropocene. These topics are among the most
13
14 181 forward looking parts of the geomorphological discipline and novel artistic approaches may be
15
16 182 useful – indeed essential – for conveying the risks and uncertainties associated with imagined
17
18 183 futures (cf. Sheppard, 2012). Many artists have latched onto the abundant imaginative
19
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21 184 possibilities offered by the Anthropocene debate, and are using novel combinations of
22
23 185 photography, film, sculpture and sound to communicate geomorphologically-relevant topics
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25
26 186 such as rapid landscape transformation, altered material fluxes, novel ecosystems, and the
27
28 187 permanence or otherwise of human impacts (e.g. Davis and Turpin, 2015). We should tap
29
30
31 188 into this creativity to help communicate geomorphology to fellow scientists and the wider
32
33 189 public, and then feed into debates about options for landscape conservation, restoration and
34
35 190 management in a rapidly changing world. Science is about communicating beautiful ideas
36
37
38 191 (Cressey, 2014), whether through written language or other visual/non-visual forms. The
39
40 192 challenge in geomorphology-art collaborations is to use approaches that communicate
41
42 193 geomorphological meaning whilst maintaining artistic integrity.
43
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45 194 46 47 195 **References**

- 48
49 196 Cotton CA. 1922. *The Geomorphology of New Zealand. Part 1: Systematic*. New Zealand
50
51 Board of Science and Art Manual No. 3, Dominion Museum: Wellington.
52 197
53
54 198 Cressey D. 2014. Infographics: truth is beauty. *Nature* **507**: 304-305.
55
56 199 Crozier M, Priestley R. 2011. Charles Cotton: New Zealand's most influential
57
58
59 200 geomorphologist. *New Zealand Geographer* **67**: 79-89.
60

- 1
2 201 Davis H, Turpin E, eds. 2015. *Art in the Anthropocene: Encounters Among Aesthetics,*
3
4 202 *Politics, Environments and Epistemologies.* Open Humanities Press London.
5
6
7 203 Dixon DP, Hawkins H, Straughan ER. 2013. Wonder-full geomorphology: sublime aesthetics
8
9 204 and the place of art. *Progress in Physical Geography* **37**: 227-247.
10
11
12 205 Ede S. 2005. *Art and Science.* I.B. Taurus and Co Ltd: London.
13
14 206 Fisk HN. 1944. *Geological Investigation of the Alluvial Valley of the Lower Mississippi River.*
15
16 207 US Army Corps of Engineers.
17
18
19 208 Frankel F. 2004. *Envisioning Science: The Design and Craft of the Science Image.* MIT
20
21 209 Press.
22
23 210 Goff J. 2012. Tsunamis and stranded vessels: up Ship Creek without a paddle? *Geographical*
24
25 211 *Research* **50**: 102-107.
26
27
28 212 Gorman MJ. 2014. The third culture. *Nature* **510**: 216.
29
30 213 Goudie A, Viles H. 2010. *Landscapes and Geomorphology: A Very Short Introduction.* Oxford
31
32 214 University Press: Oxford.
33
34
35 215 Gregory KJ. 2006. The human role in changing river channels. *Geomorphology* **79**: 172-191.
36
37 216 Gregory KJ, Lane SN, Lewin J, Ashworth PJ, Downs PW, Kirkby MJ, Viles HA. 2014.
38
39 217 Communicating geomorphology: global challenges for the twenty-first century. *Earth*
40
41 218 *Surface Processes and Landforms* **39**: 476–486.
42
43
44 219 Griffiths HM, Salisbury TE. 2013. ‘The tears I shed were Noah’s flood’: medieval genre, floods
45
46 220 and the fluvial landscape in the poetry of Guto’r Glyn. *Journal of Historical Geography* **40**:
47
48 221 94-104.
49
50
51 222 Kemp, M., 2000. *Visualizations: The Nature Book of Art and Science.* Oxford University
52
53 223 Press.
54
55
56 224 Legleiter CJ, Marston RA. 2013. Introduction to the Special Issue: the field tradition in
57
58 225 geomorphology. *Geomorphology* **200**: 1-8.
59
60

- 1
2 226 Miller AI. 2014. *Colliding Worlds: How Cutting-Edge Science is Redefining Contemporary Art*.
3
4 227 WW Norton.
5
6
7 228 Peterson G. 2008. Slow ecological art. Available at: <http://rs.resalliance.org/tag/art/page/2/>
8
9 229 [Last access date: 30th April 2016].
10
11
12 230 Rees R. 1973. Geography and landscape painting: an introduction to a neglected field.
13
14 231 *Scottish Geographical Magazine* **89**: 147-157.
15
16 232 SeriousGeoGames (no date). *SeriousGeoGames: Gamification for Earth Sciences*. Available
17
18 233 at: <https://seriousgeogames.wordpress.com/about/> [Last access date: 26th February 2016].
19
20
21 234 Sheppard SRJ. 2012. *Visualizing Climate Change: A Guide to Visual Communication of*
22
23 235 *Climate Change and Developing Local Solutions*. Routledge.
24
25
26 236 Thornbush MJ, Allen CD, Fitzpatrick FA, eds. 2014. *Geomorphological Fieldwork*.
27
28 237 Developments in Earth Surface Processes, Vol. 18, Elsevier.
29
30 238 Tooth S. 2009. Invisible geomorphology? *Earth Surface Processes and Landforms* **34**: 752–
31
32 239 754.
33
34
35 240 Tufnell B. 2006. *Land Art*. Tate Publishing.
36
37
38 241 Whalley WB. 2014. On Beck. In: Matthews S, Curry N. eds. *Norman Nicholson at 100:*
39
40 242 *Essays and Memoirs*. Bookcase, Carlisle.
41
42 243 Wilson S. 2010. *Art + Science Now*. Thames and Hudson.
43
44
45 244 Woodward J. 2015. Is geomorphology sleepwalking into oblivion? *Earth Surface Processes*
46
47 245 *and Landforms* **40**: 706–709.
48
49 246 Zumbühl HJ, Steiner D, Nussbaumer, SU. 2008. 19th century glacier representations and
50
51
52 247 fluctuations in the central and western European Alps: an interdisciplinary approach. *Global*
53
54 248 *and Planetary Change* **60**: 42–57.
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1
2 250 **Figure captions**
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4 251
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7 252 **Figure 1** 'Spiral Jetty' by Robert Smithson, constructed 1970 on the northeastern shore of the
8
9 253 Great Salt Lake near Rozel Point, Utah, USA. As lake water levels fall and rise, the jetty is
10
11 254 alternatively exposed and submerged. Originally consisting of black basalt against ruddy
12
13 255 water, the earthwork is now more white against pink owing to salt encrustation. These and
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15
16 256 other 'living sculptures' ultimately become part of the topography, and represent a unique
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18 257 class of anthropogenic landforms.
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23 259 **Figure 2** Examples of geomorphological images that also have aesthetic appeal, with A) to C)
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25
26 260 focusing on representations of river meanders:

27
28 261 A) one of the numerous maps produced by Harold Fisk to show the historical traces of the
29
30 262 lower Mississippi River, USA (see associated report by Fisk, 1944);
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33 263 B) one of the many illustrations produced by Charles Cotton, a New Zealand
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35 264 geomorphologist, to show a sequence of landscape development (Cotton, 1922). Cotton's
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37 265 simple, evocative illustrations provided inspiration for the landscape paintings of New Zealand
38
39 266 artists Colin McMahon and Bob Kerr;
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41
42 267 C) part of a colour-coded LiDAR image revealing the alluvial landforms of the Willamette
43
44 268 River valley, Oregon, USA (Dan E. Coe, Oregon Department of Geology and Mineral
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46 269 Industries);
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48
49 270 D) SEM image of a wind-blown basalt sand grain from Hawaii (R.A. Craddock, unpublished).
50
51 271 Extensive pitting on the grain surface is made visible, revealing an otherwise hidden micro
52
53 272 landscape.
54



Figure 1

Figure 1 'Spiral Jetty' by Robert Smithson, constructed 1970 on the northeastern shore of the Great Salt Lake near Rozel Point, Utah, USA. As lake water levels fall and rise, the jetty is alternatively exposed and submerged. Originally consisting of black basalt against ruddy water, the earthwork is now more white against pink owing to salt encrustation. These and other 'living sculptures' ultimately become part of the topography, and represent a unique class of anthropogenic landforms.

254x190mm (72 x 72 DPI)

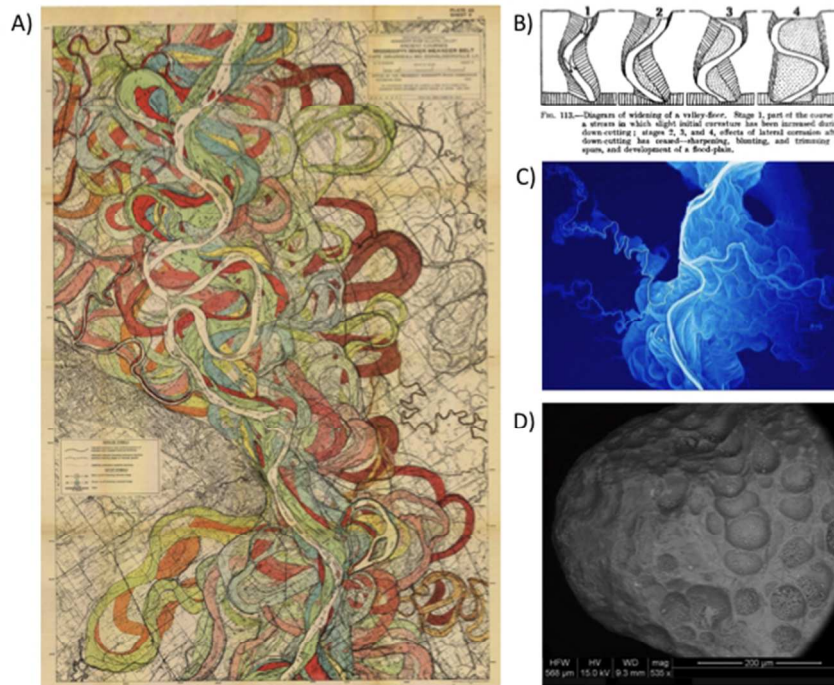


Figure 2

32 Figure 2 Examples of geomorphological images that also have aesthetic appeal, with A) to C) focusing on
33 representations of river meanders:

- 34 A) one of the numerous maps produced by Harold Fisk to show the historical traces of the lower Mississippi
35 River, USA (see associated report by Fisk, 1944);
- 36 B) one of the many illustrations produced by Charles Cotton, a New Zealand geomorphologist, to show a
37 sequence of landscape development (Cotton, 1922). Cotton's simple, evocative illustrations provided
38 inspiration for the landscape paintings of New Zealand artists Colin McMahon and Bob Kerr;
- 39 C) part of a colour-coded LiDAR image revealing the alluvial landforms of the Willamette River valley,
40 Oregon, USA (Dan E. Coe, Oregon Department of Geology and Mineral Industries);
- 41 D) SEM image of a wind-blown basalt sand grain from Hawaii (R.A. Craddock, unpublished). Extensive
42 pitting on the grain surface is made visible, revealing an otherwise hidden micro landscape.
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