Hydraulically fractured

Unconventional gas and anthropology

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Hydraulic fracturing, commonly referred to as 'fracking', is a controversial technique for recovering oil and gas from underground rock layers that has been available since the mid-20th century, but has not been commercially viable until this last decade. In conjunction with other technological advances such as horizontal drilling, fracking has helped to significantly increase unconventional gas production, initially and especially in the United States, but increasingly also in other countries around the world. In the context of global climate change, this technology has been heralded for its potential to provide a much cheaper and cleaner-burning energy source than coal and oil.

However, the operation of this technology is accompanied by major environmental issues ranging from its potential to cause environmental pollution to triggering seismic events. The governments of industrialized countries have so far been ill-equipped to provide the stricter regulation that these sophisticated techniques are said to require, and their adoption – especially in countries with weaker regulatory regimes – could pose a particular threat to human populations. These factors make this technology particularly controversial today.

In this paper, I begin by setting out some of the main aspects of global energy predictions, unconventional gas, and fracking. This provides context for discussion of disputes, anthropological research projects, and the limited published literature on the subject. Drawing on my ongoing research in the gas fields of Australia, in the third section of this paper I describe the conflicts surrounding the extraction of gas from coal seams in southern Queensland. This case material is presented thematically to illustrate the diversity of anthropological perspectives in the literature and the research currently underway.

Unconventional gas and global energy

The World Energy Outlook released by the International Energy Agency (IEA) in November 2012 includes a factsheet which opens with a pertinent warning that 'taking all new developments and policies into account, the world is still failing to put the global energy system onto a more sustainable path' (IEA 2012a: 1). This warning, a reference to both the environmental and social consequences of current energy production modes, is particularly salient in the light of projected demand. Disregarding for the moment the difficulty of making accurate predictions under changing conditions, from 2012 to 2035 global energy demand is projected to increase by over one third.

So-called 'unconventional' gas production is set to account for nearly half the growth in global gas production to 2035 (IEA 2012a), with the share of unconventional gas potentially rising from 14 per cent in 2010 to 32 per cent in 2035 (see Fig. 1). These predictions give an indication of potential magnitude, but appear not to take into account a variety of factors affecting the economics of production, including high gas well depletion rates and associated cost increases, concerns about climate change and continued reliance on hydrocarbons, and increasing community opposition to technologies such as fracking.[1]

Unconventional gas is gas previously considered difficult to extract profitably. It is contained in deep underground shale formations, coal beds (referred to as coal seams in Australia), or in geological formations that are particularly impermeable (so-called 'tight' gas). Significant reserves of unconventional gas have been found around the world in regions both sparsely and densely populated. In Australia, most coal seam gas fields are located on the populated eastern seaboard, in agricultural rural hinterlands relatively close to rural and urban centres.

Across the United States, Europe and Australia, diverse protest groups are emerging which take issue with the environmental consequences of the increased use of fracking in unconventional gas extraction. Despite local idiosyncrasies they share concerns about issues such as the industrialization of rural landscapes, food production, multinational corporate enterprise and community disempowerment, the potential for subterranean and surface water pollution, and future human and environmental health generally.

Although its safety has been questioned for some time (e.g. see Sumi 2005), an important impetus for the emergence of various protest groups was Josh Fox's 2010 Oscar-nominated activist documentary *Gasland*, filmed in the unconventional gas fields of the United States, which caused consternation around the world with its threatening images of pollution and combustible tap water.

Unconventional gas and fracking

Compared to conventional gas, unconventional gas extraction requires a greater density of wells (one or more per square kilometre) and thus much more infrastructure, including well pads, pipelines, compressor stations, processing plants, roads, and water treatment facilities. The scale of such operations has caused concern about its environmental impacts, including major changes to the landscape (see front cover image).

When gas flow needs to be increased, fracking is used to 'stimulate' the underground layers in which the gas is trapped. Small fractures are created by pumping fracking fluid (a combination of 98 per cent water, proppants – silica sand or manufactured granules which keep the fractures open – and numerous chemicals) into the shale or coal seam under enormous pressure. New drilling techniques allow these fractures to be created along horizontal lines, increasing the amount of obtainable gas per well (see Fig. 4).

Every fracked well may require up to 20 million litres of fresh water, 4,000 tons of proppants, and up to 200,000 litres of chemicals (IEA 2012a: 27; IEA 2012b: 33). In Australia, the Queensland state government intervened to ban the use of carcinogenic chemical compounds such as benzene, in fracking. Methane, the main component of natural gas, is a volatile and more potent greenhouse gas than carbon dioxide, and leakage may thus undermine the proponents' view of methane as a clean and transitional source of energy in the future. However, enticed by energy independence and security, many thousands of wells have

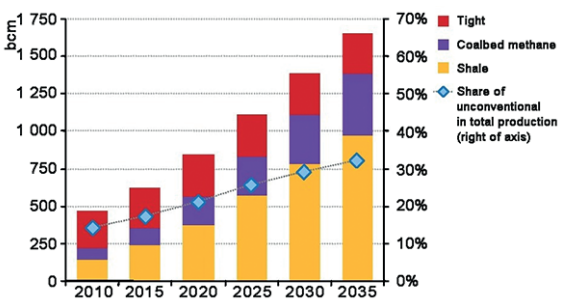

Fig. 1. *Projected unconventional gas production increases (IEA 2012b: 82).*

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Fig. 2. *Green Members of the European Parliament (MEPs) and anti-fracking activists pose with fracking-flavoured water outside European Parliament.*

been drilled in the United States thus far, and approximately 40,000 wells are planned in the Australian state of Queensland over the next few decades.

Much of the fracking fluid remains underground (50 to 80 per cent in shale operations), and may pollute poorly understood underground water resources. The fluids which flow back to the surface are also considered hazardous, including highly saline water and harmful compounds naturally occurring underground. Coal seams do not require the same level of stimulation as shale, but the coal seams must be dewatered to depressurize them and allow gas flow. In Australia, vast amounts of the resulting 'produced' water must be treated before release into the environment or re-injection into underground reservoirs. As a result of the controversies surrounding fracking, France has banned it, as did the state of Vermont in the United States, while many other places have seen the introduction of (temporary) moratoria on the use of fracking techniques until a variety of scientific risk studies are completed.

In summary, if the predicted increase in unconventional gas production eventuates, it is set to change global energy and attendant geopolitical relations. Increased conversion into LNG (Liquid Natural Gas) allows shipping of gas around the world, thus intensifying concerns where it is extracted and transported on a large scale. The required infrastructure needed to support unconventional gas extraction results in profound changes in the local landscape. Widespread public concern about the impacts of this industry have emerged, particularly with regard to fracking, surface and subterranean water, air pollution and a host of other environmental, social and health issues. In many regions, unconventional gas has been brought into production despite a poor understanding of its various potential impacts.

Research today

Energy has been of interest to the social sciences for a long time (e.g. Cottrell 1955; White 1943). However, interest in natural gas specifically has been awakened more recently as part of a portfolio of interests in the individual types of energy (e.g. Behrends et al. 2011 on oil) and in energy more broadly (e.g. Nader 2010; Spreng et al. 2012; Strauss et al. 2013).

Melosi (2010: 58) found that energy transitions historically 'are not simply exercises in swapping fuels and changing technologies, but disruptive events with the potential to remake societies in fundamental ways'. The challenge of research is to combine insights into the global and historical processes of energy production, consumption and distribution with the specific characteristics of the resource, its related technologies and the societies in which they are introduced.

A number of scholars are contributing to research on discursive framing and the political economy of fracking, which will usefully add to the broader anthropological literature on energy and 'energopolitics' (see e.g. Boyer 2011; Rogers 2011 for brief commentary). The volume by Strauss et al. (2013) *Cultures of energy: Power, practices, technologies* includes contributions on the ethnography and cultural understandings of energy, and its meaning, transformation and contest. One contribution by Elizabeth Cartwright considers the concept of eco-risk in the context of fracking. She considers risk at the intersection of 'particularly lived understanding' (drawing on Reno's [2011] work on risk, knowledge and emplacement), 'technologies of visualization and quantification' and legal standards (2013: 204). The health implications of fracking are under-researched and, she argues, any such research should engage with the enormous complexity of 'multimorbidity' (2013: 205-6) – the poorly understood interplay of multiple factors with regard to health. Cartwright's call to address complex relationships while also attending to technologies of quantification and regulatory frameworks is pertinent to other aspects of unconventional gas research, including, for example, the impact of fracking on subterranean water reservoirs or social well-being.

Sociological survey studies were published in the 2011 *Journal of Rural Social Science* special issue on unconventional gas in the United States, including analyses of key themes and variables in community perceptions of, and engagements with, unconventional gas developments.

While anthropologists have yet to fully engage these new developments, the 2012 American Anthropological Association's (AAA) annual meeting in San Francisco included an environmental anthropology panel entitled 'Energy, environment, engagement: Anthropological encounters with hydraulic fracking' and involved presentations of current research projects underway on fracking in parts of Ohio, Pennsylvania, New York State, Wisconsin and Australia. Projects cover topics such as contested landscape imaginaries and human-environment relations (Anna Willow), health and fracking discourse in the gas fields (Anastasia Hudgins), responses to fracking by affected farming communities (Jeanne Simonelli, see also Perry 2012), materiality and symbolic politics (Kim de Rijke), and the political ecology of frac sand mining and commodity chains (Thomas Pearson).

Two collaborative efforts involve a stronger applied character: a participatory film project to engender community dialogue on place and fracking (Amanda Poole) and the development of open-source collaborative information systems ('digital humanities') to enhance the documentation, sharing and collective analysis of stories from the gas fields (Sara Wylie). To facilitate cooperation among anthropologists working in this contested space, AAA panel members also created the new listserv 'Extr-act-ed'.

So, while anthropological literature on unconventional gas and fracking may as yet be limited, with these research projects underway and against a background of increased interest in the social sciences generally, this situation will likely soon change. Hopefully, research on gas company representatives, drillers, investors and others directly involved in this system of energy production – studying 'up, down and sideways' as Nader (2013: 317) argued – will allow for a richer understanding of fracking and unconventional gas disputes. Promising fields of enquiry include analyses of place and landscape imaginaries, discursive frames, and political economy. Collaborative applied research projects with affected communities have

the potential to make significant contributions to public engagement and debate.

Coal seam gas: An Australian case

Below follows my research into conflicts surrounding unconventional gas in Australia as a case study to illustrate the points made above.

Politics

In Australia, extractive industries exert considerable political influence, as evidenced in a highly effective industry advertising campaign against a proposed new federal tax on 'resource super profits', which contributed to the 2010 resignation of the then Prime Minister Kevin Rudd (cf. Wanna 2010). Similarly, in the United States, we had previously seen shale extraction exempted from aspects of federal laws including the Safe Drinking Water Act, the Clean Water Act, the Clean Air Act, and the Emergency Planning and Community Right-to-Know Act. How, then, should we understand the role of government regulation? The Australian state of Queensland might serve as an example.

Over the past few years, in the context of substantial state government debt, comparatively limited technical and human resource capacity, and revolving doors through which talented public servants may depart for well-paid industry employment, the Queensland government embraced a coal seam gas adaptive management strategy. While flexibility of regulation may be appropriate in fast-changing circumstances, the practical outcome of this approach is a reactionary regime which facilitates unconventional gas extraction.

In fact, a recent media investigation has alleged that severe political pressure was put on Queensland public servants over the implementation of gas project assessments. Multi-billion dollar projects are said to have been approved within short time-frames despite complaints by public servants about insufficient project details and environmental impact concerns (*The Courier Mail* 2013). In the context of acknowledged impact uncertainty and absent key performance indicators, the regulator has taken a 'learning by doing' approach which allows problems to become apparent before amendments are made (c.f. Swayne 2012). This looks like a questionable strategy when dealing with volatile substances, disputes and radical transformations of the landscape.

Discourse

In May 2011, the then premier of Queensland heralded the arrival of a new 'gas age'. Many billions of foreign capital investments and many thousands of new jobs linked unconventional gas extraction to the 'future prosperity' of Queensland. Echoing the findings of Finewood & Stroup (2012) with regard to neoliberal discourse in Pennsylvania, economic development and prosperity – also of rural resource regions historically in decline – are pervasive tropes of discourses arguing in favour of natural gas, whether employed by industry, governments or the wider public. In Queensland, rural communities with limited economic opportunities are indeed experiencing significant increases in economic activity after the introduction of gas fields. Many landholders have agreed to developments on their land because these provide a welcome additional income stream.

Public discourse often portrays natural resources as forms of wealth, such as 'liquid gold' (irrigation water), 'black gold' (oil) or 'buried sunshine' (coal). In certain areas, waste water is offered to farmers as irrigation water after recycling in reverse-osmosis plants. The life-giving force of water features prominently among coal seam gas companies in Queensland: images dominated by the green colours of irrigated trees on company-owned plantations adorn websites and speak to industry claims of methane as a clean transitional source of energy, supportive of environmental integrity and productivity.

In contrast, opponents use tropes of death, disease, and invasion. Aerial images of dense gas fields depict a diseased landscape in which human health and environmental integrity are said to be utterly compromised. These claims are supported by reports from various gas fields where affected residents have reported skin rashes, nosebleeds and a raft of other health complaints. Additional activist themes relate to future soil quality and food production (see Fig. 7) and a sense of nationalism played out in an ambiguous activist symbolic politics. Undertones of xenophobic politics, for example, appear in relation to concerns about unconventional gas and foreign, particularly Chinese, industries. Imagery may include references to invasion and Akubra hats (which represent 'the food producing farmer' or colloquial 'little Aussie battler'), and future generations (see Figs 5-6).

The alignment of environmental activists and largely conservative farmers is particularly ambiguous because most commercial farming operations in or near the Queensland gas fields are best understood as agribusinesses. Agribusiness in the fertile black soil regions of the Darling Downs in southern Queensland, for example, is characterized by advanced technological production methods including GPS navigation of machinery, GM (genetically modified) crops, laser-levelled land, and, at least historically, substantial water use. More appropriately represented by the industrial 'hard hat' than the historical Akubra hat, these enterprises have themselves led to severe concerns about the environmental impact of certain farming practices on soil quality and underground aquifers, particularly the vast subterranean reservoir known as the Great Artesian Basin.

Rights

The symbolic acts revolving around the small Aussie battler also refer to concerns about rights. In Australia, the state owns the underground resources. Landowners with freehold title therefore cannot stop resource extraction. But they can lock their gates to frustrate company access. Established in 2010, The Lock the Gate Alliance has become the overarching anti-coal seam gas network in Australia. In less than three years it has developed international links and represents 167 smaller member groups with more localized activist agendas across the country.

Other Australian titles to land, such as Native Title, afford Aboriginal people the right to negotiate agreements with extractive industries, but this does not afford them the right to stop extraction should they wish to do so. This right is vested only in the state and federal governments. Local (municipal) governments too are to a large degree by-passed in decision-making, although they do face the local consequences. Lastly, similar to the situation in the US, companies negotiate individual agreements with landholders which might include confidentiality clauses that prevent public discussion about the terms of compensation and other arrangements.

The extraordinary expansion of the unconventional gas industry has thus led to questions about social power and the rights of individuals and local communities, the role of multinational corporations in politics and rural service provision, as well as related questions regarding fundamental processes of democracy, capitalist economies and social justice.

The material qualities of gas and fracking

In his work on oil, gas and corporate social technologies in Russia, Rogers (2012: 293) called on anthropologists to

1. The prediction, rather, is based on what the IEA calls 'the Golden Rules Case' in which gas industries appropriately address current concerns about environmental and social impacts (IEA 2012b: 9).

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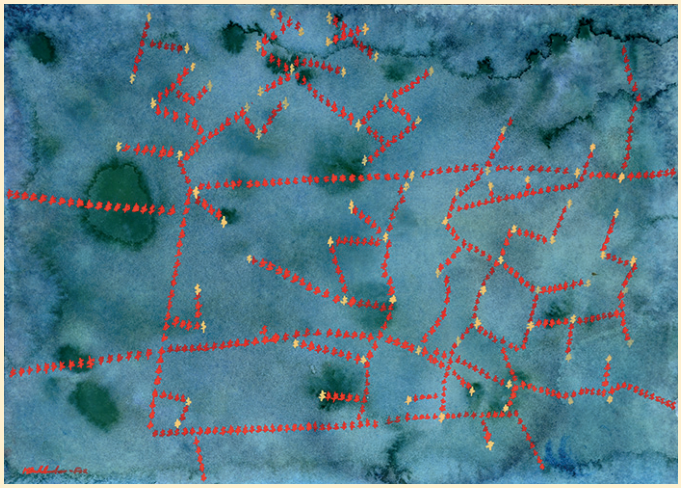

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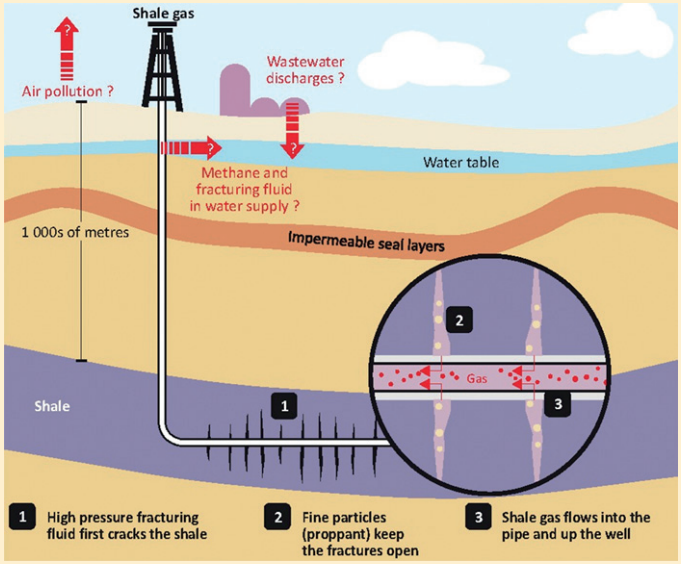

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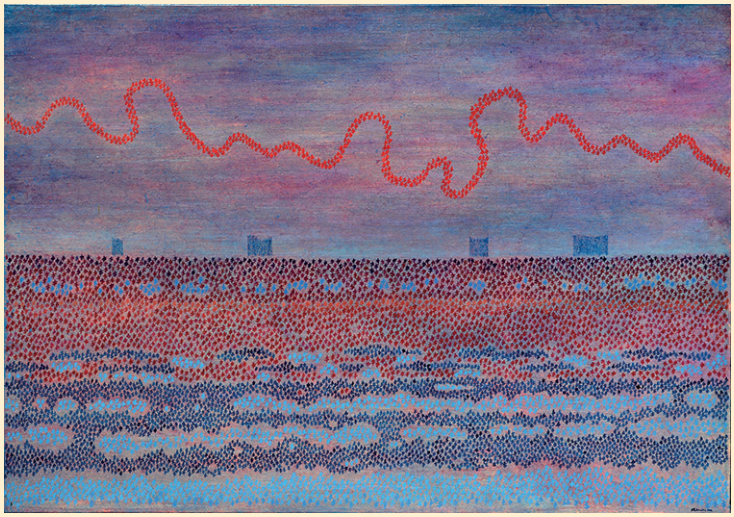

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KIM DE RIJKE

BRIAN MONK

(From above to below, left to right)
Fig. 3. *'Cooked with gas', Gouache on paper, 2010. By Kathryn Brimblecombe-Fox.*
Fig. 4. *Shale gas extraction and hazards (IEA 2012b: 26).*
Fig. 5. *Anti-gas protest: the Australian flag and hats lie thrown on the ground as a sign of resistance.*
Fig. 6. *A foreign-owned drilling operation crushes the hats of protesters.*
Fig. 7. *$oils Aint $oils-Anymore! Oil on linen, 2011, by Kathryn Brimblecombe-Fox.*
Fig. 8. *A protest: 'I [death] love coal seam gas'.*
Fig. 9. *Gas field residents with unexplained health complaints use technological devices to demonstrate the presence of gas in their private water bore in southeast Queensland.*

attend 'ethnographically to the ways in which particular qualities of these materials enter broader, and heavily politicized, fields of signification'. The material qualities of unconventional gas, fracking, and associated aspects such as pipelines, processing and export facilities, large machinery, industrial traffic and work camps are important if we are to understand current conflicts, including their discursive dimensions.

Methane is a volatile, highly flammable, odourless, and invisible substance which requires sophisticated technologies to contain (cf. Kaup 2008: 1736). In the process of extraction, methane is associated with other dangerous gases such as hydrogen sulphide (it is technically categorized as 'sour' gas where the proportion of hydrogen sulphide is significant and as 'sweet' gas where it is not).

Unless methane is mixed with hydrogen sulphide in the open air in sufficient concentration, in which case it can be smelled, humans can often only detect natural gas with technological devices (see Fig. 9). It generally produces no sound and cannot be felt unless transformed into a liquid; yet emissions of gaseous compounds associated with the extraction process are reported in gas fields in Queensland and America as accompanied by headaches and other physical reactions. During my fieldwork some affected residents reported severe anxiety about the possibility of ubiquitous but invisible substances in their day-to-day lives and environments. Others travelled the gas field region during recent floods to inspect for otherwise indiscernible bubbles that might indicate methane emissions.

Unconventional gas originates deep underground and is the product of organic decay. In that way it is the antithesis of oxygen, which is both a product and source of growth, and which methane requires in order to burn and release the energy we seek. Apart from places such as swamps and garbage dumps, subterranean natural gas is generally contained in, and by relatively stable underground geological formations.

To release unconventional gas, such stability must often be physically fractured, allowing gas to cross or diffuse those boundaries. Methane may leak from pipes and associated infrastructure, becoming what are called 'fugitive emissions'. It might 'migrate' through underground layers and contaminate aquifers or surface water, air and soils. In the process of coal seam gas extraction it must be separated from highly saline 'produced' water. It must then be compressed, chilled and converted into a liquid (LNG) to transport effectively.

These material qualities make unconventional gas an agent of change both underground and at the surface. These forms of change have a profound sensory dimension; visual, auditory, as well as olfactory. In combination with technological interventions like fracking, gas can become – in a classic Mary Douglas way – 'matter out of place'; its material qualities contribute to a sense of anxiety as it escapes above ground into the inhabited environment (cf. Jackson 2011). Such anxieties also explain the international outcry over images of dangerous material boundary crossings, including those of combustible tap water in *Gasland*.

Simultaneously, the technical capabilities to contain gas through pipes, compression, and industrial networks, also speak to cultural imaginaries of power and submission of the natural world, inspiring economic development, growth and wealth creation. Gas company websites, for example, include promotional images of complex and well maintained infrastructure. In Queensland public debates, the technological capacity to capture and develop a multi-billion dollar industry on a materially elusive substance is linked to human endurance and community perseverance in economically challenging times. Such discursive strategies draw on the material qualities of steel and complex technologies of containment, but obfuscate others, including those concerned with fracking, uncertainty and vulnerability.

Risk, knowledge and the politics of science

As implied above, and addressed specifically by Cartwright (2013), a significant part of the conflict over unconventional gas in Queensland revolves around risk, with concomitant discussions about the precautionary principle, the acceptability of impacts, and views of science as the pursuit of objective truths.

In conflicts such as these, however, the social dynamics of establishing trust, credibility, and measuring risk as part of lived experience are of the essence. Environmental activists, for example, often have an ambigious relationship with science as they negotiate, both internally and externally, the politics of esoteric expertise and 'lay' forms of knowledge based on daily embodied activity (c.f. Checker 2007; Delgado 2010; Satterfield 1997; Yearly 1996).

Public credibility of scientific knowledge may be compromised where industry funds university research programmes and specialized institutes directly. This raises ethical concerns that wealthy companies may unduly influence policy and the purview of research.

Generally, academic research into the contentious aspects of unconventional gas extraction, whether publicly funded or not, instantly becomes subject to criticism and debate far beyond the circles of academia. Digital fora bring together information from across the globe, whether on fracking, companies, politics, family stories or local blockades.

Conclusion

With energy demand rising, fossil fuel consumption is projected to increase in the coming decades. Calls for reductions in emissions in the light of climate change may not put a stop to this. Celebrated by proponents as a clean and transitional fuel, unconventional gas is envisaged to meet a significant part of this growing demand, despite high rates of well depletion and increasing cost. However, as we have seen, the unconventional gas industry has been the subject of intense conflicts around the world especially in relation to its controversial production technologies that have the potential to pollute the environment and profoundly transform landscapes.

Technologies may be invented or adjusted to help contain and mitigate the adverse effects of its deployment on the societies where it operates. Nevertheless, disputes about the potential social and environmental ramifications of this technology may not be fully contained, and anthropologists would do well to research this topic from a variety of perspectives, some of which I have touched upon above.

I have highlighted the material qualities of gas and fracking that inform the diverging attitudes and discursive frames surrounding its production and utility. Expansion of this industry is accompanied by key tropes of economic growth, investment and the promise of future prosperity. However, close relationship between governments and powerful multinational corporations brings to the fore questions about political influence and human rights.

Anthropology, with its commitment to understanding local individuals and groups in their holistic cultural contexts is well suited to contribute to these debates surrounding gas extraction and energy. Whether we seek to offer socio-cultural analyses as publicly funded academics, as social impact consultants for governments or industry, as journalists, or as activists aligned with protest movements, the unconventional gas boom presents important conundrums to attend to. ●

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